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AUTOMATIC PERSONAL WEAPON WITH ELECTRONIC MANAGEMENT AND CASELESS AMMUNITIONS

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TECHNICAL FIELD OF THE INVENTION

The present invention relates to a small caliber individual weapon definite so as to guarantee its inviolability and use by the sole entitled people in order to ensure a perfect control of its detention. For this purpose, it integrates a morphological identification (fingerprint) device of the user coupled to an electric firing system for caseless ammunitions. It is clear that this formula frees the weapon from any electromagnetic locking mechanism easy to circumvent as much as the use of traditional ammunition with case and central percussion that anybody can easily reload at home.

The present weapon is thus addressed in priority to the governments and concerned agencies for a tight control of detention as well as the enforcement against weapons proliferation. Indeed, the production of the caseless ammunition according to the invention could not be obtained in a workshop of private individual and requires a technology that only governments are capable to authorize and control.

Moreover the weapon takes advantage of the compactness which characterizes the ammunition to appreciably increase the fire power thanks to a compartmented magazine. This major asset constitutes a new evolution in the armament field since the application of the principle of the invention makes it possible to increase the fire power in proportions beyond common knowledge.

The principle of the weapon allows for the development of an innovative trigger safety easy to implement: the counter-trigger. Its principle suppresses any miscoordination, in particular in the event of stress, and its safety formula is the only one to stay permanently engaged and to be released a split second before a shooting reflex.

The weapon encompasses also a reliable and simple sealing system for the chamber of caseless ammunition, a system mastering a voluminal increase of this chamber as well as a device incorporating a separate key for full prohibition of shooting, disassembling, breech and clip manipulation.

The weapon defined as such comprises:

- a central unit,
- a clock,
- an electric source (battery...),
- a morphological device for user identification,
- an electric ignition device,
- a combined device for ignition/ejection of cartridge,
- an extractor raising device,
- a chamber sealing using mechanical or gas pressure expansion of segments,
- a gas tapping device located at the periphery of the piston head,
- a gas tapping device located at the cartridge basin,
- a cylinder head/barrel solidarisation device using spigots moved by gas,
- a magazine with two compartments,
- a sequencer device for the magazine compartments,
- a weapon recoil management device,
- a counter-trigger safety device,
- a telescopic barrel,
- a key safety locking mechanism,
- a pusher spring coupled with one or several conducting wires,
- a computer connexion port.

FORMER STATE OF THE TECHNIQUE

The US patent 5.603.179 A (Adam HEIKO B) of February 1997 describes a fool-proof mechanism for weapon trigger based on user fingerprint identification. The co-ordinates of the print are contained in a cassette unfortunately removable and thus favouring a fast change without protection since no barrier of inviolability by access code or similar is envisaged.

The device is intended to equip a weapon using classical ammunitions requiring mechanical a firing pin for ignition. An electromagnetic device connected to the identification device, ensures the prohibition of percussion as long as the identification is not assured.

It is clear that such a system is particularly easy to circumvent since it is enough to remove the electromagnet to free the weapon from its selective capacity to authorize firing with.

The author also envisages a master-power switch merely compatible with an emergency shooting.

Finally, the integration of the selective identification device involves, taking into account the remanence of the traditional rod and other transmissions elements as well as the addition of the new components (cassette or card, electromagnet, batteries...), an increase in overall volume involving an over sizing of the weapon handle prejudicial to its employment by small hands.

The present patent, on the other hand, describes an entirely electronic weapon whose elements (central unit, batteries, electronic charts...) ensuring the complete management of all functions including identification are placed in the only cylinder head without involving any volume increase. The absence of any removable card and another mechanical bolt guarantees a true the inviolability.

One counts many attempts to solve the problem of simplification of the ammunition by suppressing the cases. The majority of the suggested formulas to date concentrate towards the more or less complete combustion of the cases and towards the telescopic design of the ammunition.

The patents 86 13507, WO 93/18364 & WO 96/17220 of Dynamit Nobel describe a formula for small caliber telescopic ammunition rather complex compared to the formula retained for the present invention. These ammunitions present the particular disadvantage of ejecting a plastic obturating cap during the shooting.

The present patent proposes an improvement of the telescoped design of the caseless ammunition with, in particular, a specific housing for the electric igniter making it possible to reduce the size of the ammunition and suppress any requirement for a cap or another protection.

The use of caseless ammunition involves in addition the need for obtaining a perfectly sealed firing chamber during the propellant combustion. Many formulas were patented and tested without apparent success, undoubtedly imputable to the presence of the traditional mechanical percussion as well as the complexity of the sealing systems.

Thus the US patent 3.345.770 A (Scanlon J.J.), October 1967, proposes a weapon firing caseless ammunitions that have no extracting groove/rim. The author designs a chamber whose sealing device is ensured by a chuck comprising a seal out of plastic located between two open segments/rings. The author does not specify anything as for the leaks inherent in the opening of these segments whose section is simply squared as shown in figures 2 and 3.

The lines 22 to 24 of the § 2 inform us more on the principle of sealing retained by Scanlon. Indeed, they clearly give a report on a diameter of the O ring superior to the bore of the piston since the collar in round funnel is supposed to compress it in order to reduce at the same format, without prejudging from the frictions generating delays in closing the cylinder head, thus resulting in a deteriorated shooting rate with pending failure risks. The sealing thus clearly relies on the plastic seal that the sole head segment cannot efficiently protect from extreme gases attacks.

The choice of plastic (neoprene, Teflon... column 2 line 18) appeals some questions as far as the maximum temperature the seal can sustain is concerned, since the melting point of these materials is generally around 250 °C when the gas reaches 1800°C.

The weapon being intended for automatic firing, there is a risk that the overheating of the chamber and the segments quickly imply a softening, a cooking or a fusion of the seal with clogging, gluing to the chamber wall, jamming the weapon followed by rupture with leakage of gases towards the gunner.

To increase the longevity of the O ring, the author should have adopted two segments coupled one with the other, placed before the plastic seal (and non separated by this seal, the aft segment not ensuring proper protection) and indexed so that their openings be not in front one to the other. This solution would have had the advantage of reducing the gas leakages through the opening of the head segment and improving the conformity of both segments with the cylinder, without however ensuring a real sealing.

However, the presence of the segments framing the seal and bearing the same effort favors the hypothesis that their diameter is necessarily superior to the piston bore, if no they would not have any reason to be, the protection of the seal against extreme gases being then ensured by the piston itself.

Curiously Scanlon J.J does not evoke the consequence of this over sizing of the diameter of the segments involving an inevitable scraping/planning of the entry of the feeding ramp collar by the sharp squared section (see figure 2) of the segment acting such as a plane. This effect will appear whatever may be the profile of the collar (round-off, conical...) and the angle of attack, so tiny be it, since it governs the principle of the plane itself.

The jamming of the weapon is then unavoidable, the user having no possibility to compress the segments inside their housing to support the introduction of the chuck into its chamber, any new movement attempt of the cylinder head leading to jamming.

More hazardous yet is the ammunition destruction risk by planning effect from the segments. One easily imagines the effects of scrapers on a compacted powder propellant. Probably in order to mitigate this risk the author introduces a busc on the lower face of the cylinder head (level 44 of figure 2) whose function is obviously to produce a recess of the cartridges at the recoil time of the head of cylinder head in order to avoid any contact of the segments with the aforementioned cartridges. The author does not seem, moreover, to perceive the consequences of the necessary recess that produces the passage of this busc on the cartridges piled up in the magazine at the time of the movement of the cylinder head, with risk of wedging and blocking of the aforesaid cylinder head and destruction of the powder propellant.

Moreover, this busc could in no case avoid a contact of the segments with the base of the ammunition in spite of the presentation of the cartridges under a strong pitch angle. To be convinced it is enough to simulate the recoil of the cylinder head to note that there is an obligatorily contact, once the busc frees the base of the aforesaid ammunition, of the segments with the powder bread. The destruction of this last by scraping is then extremely probable.

Finally, no extraction device for a chambered cartridge is envisaged, exposing the user to the jamming of his weapon in the event of ammunition failure. Obliging then to withdraw the charger, open the cylinder head and push through the barrel mouth with a rod to try to extract the cartridge with the known danger in the event of long fire.

The author in addition does not specify anything regarding the sealing chamber length, determining issue for the safety of the weapon: a too short room involves a too hasty opening irremediably exposing the user and the magazine cartridges to the extreme gases of the detonation.

In conclusion, the Scanlon patent of weapon with vocation of repetition shooting by mechanical percussion of caseless ammunition corresponds to an incomplete study where the author proposes a formula with dangerous sealing relying on the use of a fragile seal composed of segments with irrational arrangement (a segment behind the plastic joint), without damage of their inevitable scraping of the collar entry and the ammunition, resulting in possible jamming of the weapon, the whole without presence of an extractor, thus exposing the user in the event of cartridge failure.

The present patent, on the other hand, mitigates these design errors thanks to the use of mechanic or gas pressure to master a uniform expansion of sized ring seals without leaks.

This formula guarantees moreover an absence of jamming during the forward breech movement and an absolute reliability against adverse temperatures. This patent ensures an electric igniting as well as a cartridge extraction capability that the Scanlon J.J patent cannot offer.

The patent FR 2.308.076 A (CIVOLANI Bruno) November 1976 describes a percussion system for weapon firing self-propelled projectiles equipped with peripheral igniters as described into the Italian patents N°932.381 and 972.058.

These projectiles constitute real caseless ammunitions but suffer from serious problems of trajectory stability and precision caused by some body deformation resulting from the percussion on the cylindrical wall of the projectile. The delay in opening the chamber is obtained by the recess of a locking pivot, similar to the chuck of the US patent 3.345.770, whose diameter is similar to the projectile's and length such that the opening intervenes after the projectile exit the gun.

The sealing of such a room is not evoked by the author who equips the chuck, on the enclosed figures, with radial grooves not mentioned in description.

It is clear that the sole presence of these grooves could not ensure a correct sealing effect, or, should they receive ring seals, prevent a breech locking during forwards movement, making the weapon dangerous of use.

Lastly, no mention of an extractor is made either in description or in the attached drawings, leading to think that the author, just like J.J. Scanlon with its US patent 3.345.770, did not know how to solve this crucial problem.

The principle of this weapon is limited to an automatic operating mode since there a systematic percussion of the projectile occurs as per the closing of the chamber. However the forwards displacement of an inertial mass at the time of the shooting involves an inexorable disturbance of the aiming sight prejudicial to the precision. Weapons (MAT 49, UZI...) functioning according to this principle are considered too unsharp and either are withdrawn from service, or modified (UZI) to adopt a delayed percussion mode.

The present patent describes, on the other hand, a particularly precise caseless ammunition since the projectile is not affected, during the shooting, by any incision or deformation likely to alter its precision. The thus proposed weapon comprises a perfectly sealed chamber equipped with an extractor of failing ammunition.

The patent FR 849 727 A (Steyr-Daimler-Puch Aktiengesellshaft) of February 1939 describes a weapon for cased ammunition automatic shooting with systematic percussion at the end of chambering said ammunition. This system suffers from the same disadvantages of the patent FR 2.308.076 A (CIVOLANI Bruno), namely a brutal projection of the cylinder to chamber the cartridge when firing, considered unsharp because of the moving masses. For information, this formula has been developed for machine-guns in order to avoid auto-igniting (cook-off) cartridges introduced in an overheated chamber. This inconvenient was overcome by the immediate percussion of cartridge primer as per the closing of the chamber. The breech/barrel solidarisation system of the patent FR 849.727 is commanded by the recoil under gas pressure tapped downstream the barrel of a piston interdependent of the striker and actuating the blocking/releasing of mobile bolts.

This system is particularly complex since it relies on mechanically driven spigots by the displacement of the striker with the inevitable problems of abrasive wear which this solution involves. If the command of the drawer piston ensuring the movement of the striker is well carried out by gas tapping, the principle of this patent requires a bulky architecture increasing appreciably the size of the weapon as much as its weight at a rate proportional to the number of elements (shirt & piston parallel to the cylinder head, ducts...). Thus, this solution requires a long driving gas tube along the barrel to tap said gazes at the extremity right before the barrel mouth.

Still more surprising is the absence of extractor in the description or in the joined drawings, leaving the reader with the feeling that the author, just like J.J. Scanlon (US patent 3.345.770) and CIVOLANI Bruno (patent FR 2.308.076 A) did not know to solve this crucial problem with its formula. We will not reconsider the effects of such negligence in case of ammunition failure.

Consequently the patent FR 849.727 suffers from a complexity of its mechanical locking device with subjacent risk of wear, a consequent number of parts, a maladjustment to the shooting of caseless ammunition, an inaccuracy resulting from the late chambering the ammunition and an incapacity to extract a failing ammunition.

The present patent describes, on the other hand, a breech/barrel locking system by spigots driven by gases directly tapped at the cartridge basin of head cylinder. This formula removes any additional piping, piston, shirt and other accessories, proves to be particularly light, easy and economic to implement (a simple milling is enough), and does not involve any weapon size increase.

This provision has the enormous advantage of avoiding any risk of blocking which could result from the modification of a tenon due to wear. Finally, the suggested formula uses caseless ammunitions that can be extracted in the event of failure which the patent FR 849.727 is unable to realize.

The patents 79 06.106, 83 07602 & 83 07603 of Heckler & Koch describe a caseless rifle whose chamber sealing system is ensured by a particularly complex device based on the 180° rotation of the chamber. The cartridge supply is carried out by gravity, leading to possible misalimentation of the weapon when tilted. The rotation of the chamber (borrowed from the principle of old water taps) does not guarantee any sealing against propellant gases free to go upwards the feeder canal. This formula involved a great complexity for the chamber slewing gear and was abandoned.

The patent FR 2.082.183 A (Manufacture Meca co. Mo), March 1970 described a safety device locking the weapon trigger under a pressure exerted on the back of the and forwards said trigger, causing the engagement of a transverse push rod for unlocking. This system relies on a "floating" assembly of the trigger with no rotation axis but using only supports via embossing: this formula prohibits any possibility of adjusting the trigger stiffness and limits its deployment to the sole weapons equipped with traditional firing pin, thus perfectly unable to answer the requirements of the weapons with electric priming. The presence of the bolt on a single side of the weapon prohibits any possible ambidextrous use and, simultaneously, deprives the user from the perception of this safety when approaching the weapon on the opposite side.

The present patent, on the other hand, integrates a trigger safety device compatible with electric mechanisms and perfectly ambidextrous, activated by a simple forwards rotation and having the particular advantage of being immediately visible and this, whatever might be the weapon side.

US patent 5.705.763 (Jorge A. LEON) January 1998 describes a device allowing for turning a semi-automatic weapon into an automatic one. Addressed to semi-automatic weapons with mobile cylinder head and mechanical percussion, this device allows a fire selection by a particular positioning of the trigger using a pressure exerted at the back and forwards so as to produce a swing. The purpose of this device is not to provide any safety function, but simply to produce a full automatic fire when the trigger is at a certain position.

The present patent, on the other hand, proposes the use of a forward trigger movement in order to block the aforementioned trigger and is not to be confused with that of a semi-auto/full auto selector.

The US patent 4.833.808 A (Stravan TRAVIS) of May 1989 describes a recoil damper system comprising a co-cylindrical mass with the barrel whose forwards projection is carried out by gases. This device, envisaged to be adapted at the end of barrel, increases the weight of the weapon and modifies its balance and length. It requires moreover a perfect harmonization of the rifling with those of the barrel in a particularly delicate assembly that the author does not approach in spite of his important and dangerous character.

This device limits are that of a counter-recoil one whose effectiveness is closely related to the synchronization with the aft movement of a breech cylinder head that the author does not approach.

The present patent, on the other hand, stipulates:

- a recoil absorber mechanism via a short backwards movement of the barrel aiming at a solidarisation barrel/breech intended to ensure an opening delay,
- a forward barrel extension telescopic device to increase the power of the ammunition by carrying out an expansible room.

In addition to compensating the effect of recoil, these devices ensure a most different function from that of TRAVIS patent.

The patent DE 90 17 151.9 U (FIELD R.C.), December 1990 describes a specific magazine/clip for caseless ammunitions, compartmented into two separate funnels placed out of tandem. The sequencing of the various compartments is carried out via rocking-levers actuated by the first ammunition of each follower, as per the end of the preceding. This device presents several disadvantages, namely:

- impossibility to use other ammunitions profile than rectangular,
- impossibility to handload the compartments by the top of the magazine, requiring a unpractical specific device and a feeding by the bottom,
- risk of jamming the weapon by wedging of the feeding push (7) rod in the magazine, prohibiting then any withdrawal from said magazine,
- fragility of the rocking-levers (4) swivelling on an axis arranged within a thin wall leading to possible jamming,
- obligation to load the compartments in a precise order (front, back then medium) under penalty of blocking the rocking-lever of the compartments which would not have been supplied under this rule,
- limitation of use of the magazine to the sole weapon equipped with a push rod.

The present patent, on the other hand, describes the operation of a magazine for caseless ammunitions comprising two compartments easily and independently loadable, whose sequencing is ensured by a mechanism located on the weapon which does not require any push rod and its inherent jamming risk.

DESCRIPTION OF THE INVENTION

The invention is composed of a weapon specifically adapted to the semi-automatic and automatic firing of caseless ammunitions. The use of these ammunitions requires an electric ignition and a specific chamber sealing device such as defined hereafter.

Description of drawings 1 to 28/28 :

Drawing 1/28 comprises 4 figures (1/1, 1/2, 2/1 & 2/2) describing the principle of a caseless ammunition equipped with a solid propellant either positioned aft (1/1 & 1/2) or in a telescopic mode (2/1 & 2/2).
Drawing 2/28 comprises 1 figure (3) presenting the seen from above view of the cutaway gun unit/cylinder head/chuck with the extractor mechanism.
Drawing 3/28 comprises 2 figures (4 & 5) presenting the cutaway of the gas tapping system at the cylinder head.
Drawing 4/28 comprises 4 figures (6/1, 6/2, 6/3 & 6/4) presenting the chamber sealing system by expansion of segment under gas pressure tapped at the piston head.
Drawing 5/28 comprises 4 figures (6/5, 6/6, 6/7 & 6/8) presenting the chamber sealing system by expansion of segment under gas pressure tapped at the periphery of the head of the piston.
Drawing 6/28 comprises 3 figures (6/9, 6/10 & 6/11) presenting the chamber sealing system by expansion of concentric segments under gas pressure tapped at the periphery of the piston.
Drawing 7/28 comprises 3 figures (6/12, 6/13 & 6/14) presenting the chamber sealing system by expansion of encased segments. Figure 6/12 presents a longitudinal cross-section of the head of piston, figure 6/13 presents the side view of the external segment bayonet, figure 6/14 presents the top view of the assembly of two encased segments (41 quarter) and (41 quint).

Drawing 8/28 comprises 5 figures (6/15, 6/16, 6/17, 6/18 & 6/19) presenting a sealing process based on a corolla working in both expanding/contracting modes by a combined effect of variation of curve and torsion of its section.

Drawing 9/28 comprises 7 figures (6/20, 7/1, 7/2, 7/3, 7/4, 7/5 & 7/6) presenting the mechanisms of chamber sealing under gas and mechanical expansion of segment.

Drawing 10/28 comprises 2 figures (7/7 & 7/8) presenting the delay mechanism at the opening of cylinder head/barrel by spigots driven by gases and placed in the barrel (7/7) or in the chuck (7/8).

Drawing 11/28 comprises 2 figures (8 & 9) presenting the cross-section of the weapon and its mechanism of short barrel recoil, counter-trigger safety engaged.

Drawing 12/28 comprises 2 figures (10 & 11) presenting the cross-section of the weapon with the anti-recoil device and the counter-trigger safety engaged.

Drawing 13/28 comprises 1 figure (12) presenting the cross-section of the weapon with released trigger guard.
Drawing 14/28 comprises 1 figure (13) presenting the cross-section of the weapon with opened trigger guard.
Drawing 15/28 comprises 2 figures (14 & 15) presenting the magazine cross-section, the front compartment equipped with a remaining cartridge and the aft compartment fully loaded, the loading limitation device of the aft compartment and the process for arranging the ammunitions in three piles.
Drawing 16/28 comprises 3 figures (16, 17 & 18) presenting the magazine cross-section when engaged in the weapon with front compartment fully loaded, the head cartridge resting against the cylinder head (chuck) and the ammunitions of the aft compartment (17) kept down in their well under the action of the cartridges stopper, the loading limitation device of the aft compartment authorizing an additional recess.
Drawing 17/28 comprises 1 figure (19) presenting the cross-section of the weapon magazine engaged, a remaining ammunition in the front compartment and two kept inserted in the aft compartment under the action of the coupling mechanism.
Drawing 18/28 comprises 1 figure (20) presenting a cross-section of the weapon, the coupling mechanism before opening with the hook locking the arm of the cartridge stopper.
Drawing 19/28 comprises 1 figure (21) presenting a cross-section of the weapon and magazine compartments coupling mechanism at the opening of the hook releasing the arm of the cartridge stopper under the action of the front transporter button.
Drawing 20/28 comprises 1 figure (22) presenting the cross-section of the weapon with engaged magazine, front compartment empty and aft one with two cartridges after release of the cartridge stopper.
Drawing 21/28 comprises 1 figure (23) presenting the cross-section of the weapon with its breech stopper device and its quadruple locking mechanism: trigger guard, counter-trigger safety, breech and clip well, prior installation of the locker.
Drawing 22/28 comprises 1 figure (24) presenting a cross-section of the weapon and its quadruple locking mechanism: trigger guard, counter-trigger safety, breech and clip well, locker in place.
Drawing 23/28 comprises 1 figure (25) presenting the rail-sight device for fast target acquisition and its adjustment system per thumb screw.
Drawing 24/28 comprises 1 figure (26) presenting the retracted telescopic barrel.
Drawing 25/28 comprises 1 figure (27) presenting the extended telescopic barrel.

Drawing 26/28 comprises 1 figure (28) presenting the cross-section of the electronic weapon with electric firing chuck, fire selector, clip well, cartridge counter, fingerprint recognition and fire release block, batteries and their housing.

Drawing 27/28 comprises 1 figure (29) presenting a cross-section of the electronic weapon comprising a roto-selector for triggered fire sequences.

Drawing 28/28 comprises 1 figure (30) presenting the organizational diagram of the electronic map for user identification and fire command.

DESCRIPTION OF THE AMMUNITION (drawings 1/28, fig. 1, 1 bis, 2 & 2 bis)

The weapon is adapted to fire any type and calibre of caseless ammunition whose general form is cylindrical and comprises an extraction groove at the aft. Thus, the ammunition can indifferently be made out a front projectile (1/1 & 1/2) coupled to a solidified (2) propellant at the back or be of the telescoped (2/1 & 2/2, n°13) type, i.e. composed of a bullit (13) drowned into a body (14) of solid propellant with, at the back, a receiving groove for the extractor (6) claw. The aforementioned bullit may comprise at its back a basin (15) containing an agent (5) intended to ignite the propellant and its position in the gangue is such that it can be sealed by a conducting and combustible cover (4).

This provision ensures an excellent protection of the primer against any risk of misfire by building an anti-radiation cage of the Faraday type. The exceptional compactness of the ammunition thus obtained will be profitable to increase the fire power.

Note: an alternative ammunition (pl. 1/28, 1/2) with the propellant coupled at the back may be obtained by prolonging the cap into a skirt (3) covering said propellant and, moreover, the extraction groove in order to prevent any propellant deterioration in the event of violent ejection, in particular with high inertia cartridges (large caliber for example). Any other formula aiming to strengthen the extraction groove would follow the same logic.

Manufacturing processes of the ammunition

The propellant is either moulded at the back of the bullit or around it in order to carry out a gangue (14) in a sole operation. The primer is positioned first or after the propellant over moulding, the conducting swatch being affixed at the end of the operation in order to guarantee the best ammunition sealing. This formula offers many advantages either in terms of cost reduction as in terms of sealing efficiency. The addition of a tracing mixture at the bottom of the bullit will favor an eye catch only from the aft sector, accentuating the discretion when firing.

DESCRIPTION AND OPERATION OF THE WEAPON (drawings 2 to 28/28)

The chosen weapon for demonstration is preferentially but not exclusively an automatic handgun, the principle of the invention being possibly extended to all calibers and types of weapons. The weapon operates according to a chamber sealing principle using a piston cylinder head producing a delayed opening during its back course. This sealing principle can be adapted to any gauge of weapons (including artillery).

The weapons of traditional design use ammunition with case, this last ensuring the chamber sealing during the course lapse of time separating the firing from the exit of the ammunition of the barrel. The delay in opening the breech is then generally obtained by blocking the case in the chamber via a connection barrel-slide maintained fixed during the travel of the ammunition in the barrel.

In the case of caseless ammunition according to the invention, the sealing and the opening delay, necessary to an optimal output of the weapon, are simultaneously ensured by one or more segments located at the periphery of a piston (18), interdependent of the cylinder head, whose recoil is progressive in a sealing chamber (62).

This chamber (62) is in the prolongation and contiguous to the chamber of ammunition (61) comprising, discretionary:

- a receiving housing for raising (59) the extractor from the ammunition groove,
- a vent (90) for propellant gas tapping located close to the chamber entry,

and the aforementioned piston chamber (62) comprising, as required, housing (56 bis) for solidarisation spigots between barrel and piston.

This solution guarantees an absolute safety by designing a perfectly sealed chamber during the firing, suppressing any specific risk inherent to the current solutions who rely on the fragile strength of a case too often sollicitated by several reloading.

As a matter of fact, weapons with cased ammunitions show a conceptual weakness generally ignored by users: their strength during the firing follows the principle of resistance of a chain, subordinated to that of its weakest link. The case is, with many regards, this weakest link.

The case acts not only as a seal when it is plated against the walls of the chamber at the beginning of the burst, but bears the whole load at its aft part (base). But, this part is, on the majority of the current automatic weapons, precisely outside the chamber conditioning its sealing effect to its sole resistance.

One consequently measures the importance of the risk to users that the formula exposes, and whose logic of case is historically borrowed from revolvers who, in turn, guarantee a better resistance since the bottom of the case is drowned into the revolving chamber and is fully supported by the shield (back of the revolving barrel) during the shot.

Users of automatic weapon are therefore exposed to the risks of cracks at the level of the primer cupola as well as the case wall itself, in particular at the base level, and to the terrible release of extreme gases which follows. Many listed accidents after successive reloads are there to testify it.

The weapon according to the invention ensures, on the other hand, a perfect firing safety based on a technique of total drenching the ammunition by a piston in a chamber whose sealing is ensured by a self-expansible seal during the shooting. This formula offers the resistance of the thick steel walls of the piston and chamber with no comparison with that of brass cases.

The weapon uses, in a first operating mode, a barrel fixed to the frame and is thus composed of a restricted number of parts. This characteristic should trigger important economic repercussions in terms of maintenance, production cost, reliability and rate of fire.

The weapon includes two principal parts (drawings 2 to 28/28):

1 - The slide/breech unit or mobile cylinder head.

- (16) slide/breech or mobile cylinder head,

- (17) chuck of cylinder head.

The chuck of cylinder head comprises the body of piston and the skirt:

- (18) piston,
- (20) skirt,
- (20 bis) head of skirt,
- (21) extractor,
- (22) extractor with foot,
- (23) extractor push rod,
- (24) extractor push rod spring,
- (25) igniter/ejector damper,
- (26) striker/valve,
- (27) igniter/ejector,
- (28) insulator of igniter,
- (29) igniter spring,
- (30) extension of igniter/ejector,
- (39) longitudinal channel of gas supply (communicating with 40),
- (40) radial channel for gases (communicating with 39),
- (40 bis) gas supply groove (communicating with 42 (a)),
- (40 ter) light or crenel for gas supply,
- (40 quarter) head of piston,
- (41) ring seal,
- (41 bis) ring seal with trapezoidal profile,
- (41 ter) ring seal with dissymmetrical trapezoidal profile,
- (41 quarter) internal segment with right angles profile,
- (41 quint) external segment with right angles profile,
- (41 six) closed expansible annular segment,
- (41 sept) closed corolla ring seal,
- (41 oct) rotulant corolla,
- (41 nove) rotulant corolla with crown,
- (41 ten) crown of corolla,
- (41 eleven) piston with integrated rotulant corolla,
- (42) segment or corolla housing,
- (42 bis) groove for gas circulation,
- (42 ter) pin,
- (42 quart) housing groove for segment or corolla base,
- (42 quint) sealing shoulder,
- (42 six) shoulder of sealing,
- (42 oct) staging disc for corollas,
- (42 nove) conical shoulder for corolla crown clearance,
- (43) longitudinal gas channel opening,
- (44) central sleeve,
- (44 bis) head of central sleeve,
- (44 ter) central sleeve spring,
- (45) sealant abutment of central sleeve,
- (45 bis) conical bearing,
- (45 ter) conical bearing,
- (45 quarter) stage sits of expansible disc,
- (46) expansible disc,
- (47) spring-pump,
- (48) conical bearing sealing the ammunition housing,
- (50) housing of the push rod unit of extractor (23), spring (24) and ejector abutment (25),

- (51) sealing cone for chuck sleeve,
- (52) communication port with the channels (39 & 40) of gas supply,
- (54) spherical tenon,
- (54 bis) ball,
- (55) conical tenon,
- (56) housing for locking spigots,
- (56 bis) housing for chamber spigots,
- (56 ter) slide tenon housing.

2 - The frame unit with barrel and magazine:

- (57) pusher spring,
- (58) barrel rifling entry,
- (59) slope for raising the extractor,
- (60) barrel,
- (61) ammunition chamber,
- (62) sealing chamber and piston housing,
- (63) frame/carcass,
- (64) trigger,
- (65) trigger return spring,
- (65 bis) counter clockwise trigger return spring,
- (66) trigger guard bolt,
- (66 bis) warp end of trigger guard bolt,
- (67) housing for warp end of trigger guard bolt,
- (67 bis) circular cam,
- (67 ter) setback,
- (68) counter-trigger,
- (69) counter-trigger housing,
- (70) counter-trigger return spring,
- (77) abutment for ejection,
- (78) slide course abutment,
- (78 bis) slide arrester,
- (78 ter) tenon notch,
- (79) lever for magazine bolt,
- (80) hook for magazine bolt,
- (81) fire selector,
- (81 bis) fire selector lever,
- (90) counter-recoil gas port,
- (91) radial gas channel,
- (92) counter-recoil gas tube,
- (93) gas vent,
- (94) slide gas tube obturator,
- (95) magazine with two tandem compartments,
- (95 bis) inclined to X degrees side wall of magazine,
- (95 ter) inclined to Y degrees side wall of magazine,
- (96) lips for both magazine compartments,
- (97) front magazine compartment,
- (98) aft magazine compartment,
- (98 bis) central inter-compartments wall,
- (98 ter) driving slit for aft conveyer pin,
- (99) front transporter,
- (100) aft transporter,
- (100 bis) aft transporter pin,
- (101) transporter button,
- (102) hook arm of cartridge stopper,
- (102 bis) cartridge stopper hook pin,
- (102 ter) cam for opening the cartridge stopper hook,

- (103) aft compartment cartridge stopper,
- (103 bis) horizontal abutment for cartridge stopper,
- (103 ter) locking-arm of cartridge stopper,
- (104) return spring for cartridge stopper,
- (105) receiving notch for magazine bolt hook,
- (105 bis) conveyer abutment,
- (105 ter) back compartment capacity limiter strip,
- (106) capacity limitation bar for the back compartment,
- (106 bis) limitation bar return spring,
- (106 ter) receiving slit of the back conveyer pin,
- (107) barrel bedding,
- (108) receiving grooves for the barrel guide rails,
- (109) horizontal rails for barrel guidance,
- (110) shock absorber,
- (110 bis) pusher spring,
- (111) bayonet abutment ring for barrel course,
- (112) bayonet spigots for ring fixing,
- (113) locker housing,
- (114) removable locker,
- (115) magazine well locker,
- (115 bis) warp end of magazine well locker,
- (116) return spring for magazine well locker,
- (117) U shaped aiming rail,
- (118) thumb screw,
- (118 bis) clicker,
- (119) connecting part between aiming rail/thumb screw,
- (120) front sight,
- (121) circlips between connection part/aiming rail,
- (122) pivot of aiming rail,
- (123) substrate applied to the front face of the trigger,
- (124) electronic firing chuck,
- (125) master switch,
- (125 bis) rotating fire selector,
- (125 ter) data routing wire,
- (125 quart) routing wire from the trigger,
- (126) contactor for single fire,
- (127) contactor for burst fire,
- (128) micro-switch for cylinder head closure,
- (129) contactor for type of magazine identification,
- (130) elevation switch of front conveyer (full & empty),
- (131) elevation switch of back conveyer (full & empty),
- (132) display,
- (133) central unit and biometrical identification module,
- (134) battery,
- (135) storage of authorized users prints,
- (136) storage of habilitant users prints,
- (137) port,
- (138) internal telescopic barrel,
- (138 bis) internal barrel shoulder,
- (138 ter) internal barrel,
- (139) barrel bedding,
- (140) external barrel,
- (140 bis) external barrel shoulder,
- (140 ter) internal shoulder,
- (141) return spring,
- (142) abutment for telescopic barrel,
- (143) conical collector.

CHAMBER SEALING PROCESS

First mode (drawing 4/28, fig.6/1 to 6/4):

In a first mode of mastering the chamber sealing, the chuck skirt (20) comprises a receiving housing (42) for only one (41) or a couple (fig.6/3) of sealing segments (41 quart & quint). This housing (42), made up of a circumferential groove whose size and section are adjusted with that of (or) the segment(s), is characterized in that it incorporates a second concentric and deeper groove (42 bis) for gas circulation, comprising radial channels or openings (40) communicating with channels (39) parallel to the central axis of the piston and emerging in the receiving basin for cartridge. The segment or the couple of ring seals (41, 41bis, quart & quint) adopts a suitable section: square (41), trapezoidal symmetrical (41 bis) or dissymmetrical (41 ter), in angle, square or any other adapted formula and are preferentially but not exclusively of the open bayonet (6/2 & 6/3) type or other and characterized in that, in the case of a couple, their assembly is concentric and superimposed i.e. one inside the other and such as, retracted in home position inside the receiving groove, the external diameter of the segment or couple of segments remains lower than the bore or diameter of the piston. The curve at rest of the aforesaid segments is such as they marry perfectly, during the expansion, the receiving chamber of the piston.

The superimposed segments, from which the respective thicknesses and heights can be different, are assembled indexed so that the opening of one be not in front of that of the other. For this purpose, each segment comprises at the higher level of its opening a notch of size corresponding to that of a pin (42 ter). The two segments are assembled in such way that their respective notches cooperate with the radial pin (42 ter) corresponding placed in the receiving groove and ensuring their indexing at 180°.

In the case of segments with section at right angles or L, the indexing, preferentially at 180 °, can be obtained either by the presence of an element, pin type, interdependent of one of the segments and cooperating with the opening of the other which comprises a notch of reception of this element, the two segments being then free mounted in their receiving groove, or by the presence of pins (fig. 6/12, 42 ter) placed in the receiving groove in such way that their head be respectively projecting into the bayonet opening of the corresponding segment. For this purpose, the openings will comprise a notch intended to accommodate the aforementioned heads of pins.

Operating Principle

At the beginning of the burst the propellant gases borrow the conducts (39 & 40) leading to the internal face of the segments (41, 41 bis, ter, quart & quint) that pressure, uniformly distributed by circulation in the second groove (42 bis), dilates radially which causes to plate the segments against the wall of the chamber (62).

The sealing is then ensured by the combination of:

- the valve effect between a plane face of the (or) segment(s) and the side wall of the piston groove,
- the contact between the peripheral (under the pressure of gases) uniformly circumferential stage of the segment (external) and the cylinder bore,
- the systematic obturation, by the opposite indexing of the segments, of any window that may arise at the opening of the couple of segments during their expansion,

and perdure as long as the pressure of propellant gases is exerted, i.e. during the bullit travel in the barrel and the simultaneous blowback of the piston in its chamber.

As soon as the bullit leaves the barrel the pressure falls instantaneously, the elasticity of the segment (or couples of segments) causes its/their retraction inside the groove and suppresses any risk of blocking the piston at the entry of the receiving chamber (62) during the front movement of the cylinder head. The dilatation of the segment (or couples segments) guarantees a perfect cartridge (61) chamber sealing during the back movement of the piston.

In order to guarantee a great longevity to the segments, these will be made out of an elastic material (UE9P, steel, cast iron bronzes...) able to resist the efforts of temperature.

Frictions of the segment in contact with the wall of the cylinder may be reduced by the adoption of a slightly convex external face (some 1/100 of millimetre) and the application of self-lubricating treatment (titanium nitride, Diamond Like Carbon, amorphous carbon, molybdenum, graphite...) suitable.

This device constitutes a true regulating system for chamber opening delay under gas pressure. The advantage of this formula is to allow the weapon "to digest" a large variety of ammunition with different masses, without requiring modification of the barrel or mass of the cylinder head, and taking care, however, that the length of back course of the piston in its chamber be sufficient enough for the type of ammunition considered.

Second mode (drawings 5/28, fig. 6/3 & 6/5 to 6/8):

In a second mode of mastering the sealing, the piston head comprising a housing (42) for a single segment or a couple (fig. 6/3) of concentric and superimposed ring seals (encased one in the other) is characterized in that said housing (42) of the segment(s) is dug with a secondary concentric and deeper groove (42 bis) favoring gas circulation and that said housing bears longitudinal grooves (40 bis) in a variable number and symmetrically distributed around the periphery of the piston head, the aforementioned grooves (40 bis) emerging at the level of the front face of the piston in order to ensure the distribution of gases towards the groove (42 bis) with which they communicate.

The segment or the couple (fig. 6/3) of ring seals (41, 41 bis, ter, quart & quint) adopts a suitable section: square (41), trapezoidal (41 bis & ter), in angle, (41 quarter & quint) or any other adapted formula and are preferentially but not exclusively of the bayonet (fig. 6/2) type or other and characterized in that they are, in the case of a couple, concentric and superimposed i.e. one inside the other and such as, retracted in home position inside the receiving groove, the external diameter of the segment or couple of segments remains lower than the bore or diameter of the piston. The curve at rest of the aforesaid segments is such as they marry perfectly, during the expansion, the receiving chamber of the piston.

The superimposed segments, whose respective thickness and height can be different, are assembled indexed so that the opening of the one is not compared to that of the other. For this purpose, each segment comprises at the higher level of its opening a notch of size corresponding to that of a pin (42 ter). The two segments are assembled in such way that their respective notches cooperate with the radial pin (42 ter) corresponding placed in the receiving groove and ensuring their indexing at 180°.

In the case of segments with section at right angles or L, the indexing, preferentially at 180°, can be obtained either by the presence of an element, pin type, interdependent of one of the segments and cooperating with the opening of the other which comprises a notch of reception of this element, the two segments being free mounted in their receiving groove, or by the presence of pins (fig. 6/12, 42 ter) placed in the receiving groove in such way that their head be respectively projecting into the bayonet opening of the corresponding segment. For this purpose the openings will comprise a notch intended to accommodate the aforementioned heads of pins.

Operating Principle

At the beginning of the burst, the propellant gases follow the peripheral grooves (40 bis) of the piston head and exert a pressure uniformly distributed (symmetry of the grooves) on the upper side face of the segment(s) (41, 41 bis, 41 ter, quart & quint) as well as on their internal face by circulating in the groove (42 bis), which causes the segment(s) to plate against the lower wall of the groove housing (42) and to dilate radially against the wall of the chamber (62) for a perfect sealing. In order to facilitate its expansion under the effect of the gas pressure surrounding the piston head, the segment or couple of segment may adopt a trapezoidal profile (41 bis) symmetrical or dissymmetrical (fig. 6/7, 41 ter) assembled such as its tilted face be directed towards the piston head, the smaller side (or top) corresponding to the internal face of said segment.

The receiving groove (42) will adopt a corresponding profile. As per the expansion of the segment (or couple of segments) under the effect of gases brought through the longitudinal grooves, the tilted side face (trapezoidal) of the segment (or couple of segments) trap the peripheral gases which surround the piston head, this ensemble exerting then a pressure which tends to plate the segment (or couple of segments) in a perfectly uniform way against the wall of the chamber and the sidewall of the piston groove ensuring thus the sealing.

As soon as the bullit leaves the barrel the pressure falls instantaneously, the elasticity of the segment (or couple of segments) causes its retraction inside its groove and suppresses any risk of blocking the piston at the entry of its receiving chamber (62) during the next forwards movement of the cylinder head.

In order to guarantee a great longevity to the segments, those will be made out of an elastic material (UE9P, steel, cast iron bronzes...) able to resist the efforts of temperature. Frictions on the cylinder wall may be reduced with the adoption of a slightly convex external sidewall (some 1/100 of millimetre) and the application of suitable self-lubricating treatment (titanium nitride, Diamond Like Carbon, amorphous carbon, molybdenum, graphite...).

This device constitutes a true regulating system for chamber opening delay under gas pressure. The advantage of this formula and to allow the weapon "to digest" a large variety of ammunition with different masses, without requiring modification of the barrel or mass of the cylinder head, and taking care, however, that the length of back course of the piston in its chamber be sufficient enough for the type of ammunition considered.

Third mode (drawings 6/28, 6/9, 6/10 & 6/11):

In a third mode of mastering the sealing, the cylinder head of the piston is characterized in that the cartridge receiving basin comprises radial lights (channels) or crenels (40 ter), symmetrically arranged at the periphery, ensuring the communication between the interior of said basin and the circumferential housing groove (42) of a segment or a couple of concentric and superimposed segments (fig. 6/3), located around the piston at the level of said basin. The segment (s) housing (42) is sized and section adjusted to said segment (s). In the case of use of radial lights, a variable number of vertical grooves (40 bis) is symmetrically distributed at the periphery of the piston head to ensure the distribution of gases at the level of the front face of the aforesaid piston in order to forward them to the back face of the segment (or couple of segments) and to combine their efforts with the gases coming from the basin through the lights. A groove (42 bis) for gas circulation may be arranged if necessary to combine the advantages of the first and second modes. The segment or the couple of ring seals (41, 41bis, ter, quart & quint) adopts a suitable section: square (41), trapezoidal, in angle, (41 quart) or any other adapted formula and are preferentially but not exclusively of the open bayonet type (fig. 6/2) or other, in the case of a couple mounted concentric and superimposed i.e. one inside the other, and characterized in that they are retracted in home position inside the receiving groove, the external diameter of the segment or couple of segments remaining lower than the bore or diameter of the piston. The curve at rest of said segments is such as to conform perfectly, during the expansion, to the receiving chamber of the piston.

Operating Principle

At the beginning of the burst the propellant gases borrow the peripheral lights or crenels (40 ter) of the cartridge receiving basin and immediately exert a uniformly distributed pressure (symmetry of the crenels and lights) on the internal peripheral side of the segment or couple of segments (41 quart & quint) as on the radial face which is directly perpendicular in the case of a section in angle or square, which causes to plate the segment or couple of segments against the lower side of the groove housing (42) and to radially dilate them against the wall of the chamber (62) for a perfect sealing. No leakage of gases through the segments openings during their expansion is possible since their concentric, superimposed and indexed assembly at 180° ensures a reciprocal and automatic obturation.

As soon as the bullit exits the barrel the pressure falls instantaneously, the elasticity of the segments causes their retraction inside their groove and removes any risk of blocking the piston at the entry of the receiving chamber (62) during the next forwards movement of cylinder head.

In order to guarantee a great longevity to the segments, those will be made out of an elastic material (UE9P, steel, cast iron bronzes...) able to resist the efforts of temperature and friction. A self-lubricating treatment (titanium nitride, Diamond Like Carbon, amorphous carbon, molybdenum, graphite...) may also be applied.

This device also constitutes a true regulating system for chamber opening delay under gas pressure. The advantage of this formula and to allow the weapon "to digest" a large variety of ammunition of different masses, without requiring modification of the barrel or mass of the cylinder head, and taking care, however, that the length of back course of the piston in its chamber be sufficient enough for the type of ammunition considered.

Note: (drawing 7/28, fig. 6/12 to 6/14): the sealing of the segments expansion device according to the above mentioned modes may be increased by the use of two segments (41 quart & quint), with a profile preferentially but not exclusively out of square or L and with bayonet opening (fig. 6/13), concentric assembled and indexed at 180° such as the short (or horizontal) branch of their section penetrates in a circumferential groove (42 quart) dug on the lower edge of the receiving groove (42) of said segments and forming a shoulder (42 quint). When the piston recoils the friction of the external segment (41 quint) against the wall of the receiving cylinder, whose effect could be reduced by the adoption of a slightly convex outside (some 1/1000 of millimetre) and the application of treatment (thermal, surface...) suitable, exerts a force tending to lift up the segments towards the head of piston. The short branch of the L section of the internal segment (41 quarter) then bumps into the shoulder (42 quint) forming thus a sealing and preventing any gas leakage circulating at the back of the segments.

The internal segment (41 quart) preferentially comprises a bayonet opening on the short branch of its section such that its opening (h) be shorter than the opening of said segment once dilated on the shoulder (42 quint). The external segment (41 quint) comprises a bayonet opening on its two branches so that a perfect sealing be ensured by the couple of segments independently of the friction effects tending to lift it up or the gas pressure tending to plate it on the lower face of the receiving groove.

The two segments thus assembled operate a sealing effect resulting from a double action:

- against the piston peripheral gases blocked by the perfect contact of the external segment and its bayonet against the chamber wall,

- against circulating gases at the back of the segments, blocked by the valve effect ensured by the short (or horizontal) branch of the segments (41 quart & quint) playing between the shoulder (42 quint) and the lower side face of the groove (42) according to whether:

  - the pressure of gases pushes the two segments towards the bottom of the piston and plate their short branch against the aforementioned lower side face (42), the bayonet of the external segment combined with the internal segment prohibiting any escape then,

  - frictions of the external segment (41 quint) against the chamber tend to lift up the two segments whose short branches (horizontal) bumps into the shoulder (42 quint) to produce a perfect mechanical sealing.

The segments expansion device according to these modes, in particular the latter since it ensures a perfect sealing, is likely to find application in the field of the spark-ignition engine.

The head segment of the piston, in permanent contact with the chamber wall, would benefit from an addition of compressive force against the lower side of its housing groove, reinforcing the chamber sealing and preventing any risk of uncontrolled vibratory mode, in particular when the piston reaches its highest point (inertia of the segment) at high regime.

Fourth mode (drawings 8/28, fig. 6/15, 6/16 & 6/17, 6/18, 6/19 & drawing 9/28, fig. 6/20):

In a fourth realisation mode, compatible with any of the three aforementioned ones (gas tapping at the cartridge basin level by channels (39, 40), grooves (40 bis), lights or crenels (40 ter) radial...), the sealing relies on the use of one or more rotulant corollas (41sept, 41 oct, 41 nove), assembled in series on the piston, the opening directed towards the head, and characterized in that:

- the thickness of the section is regularly decreasing, according to a preferred but not exclusively curved generating line, ranging from the base (B) to the upper edge (O) in order to favor, under gas pressure or a narrowing in the chamber (62), an elastic radial variation of the curve combined with a torsion of the complete section (fig. 6/17) which swivels around the round interior edge (fig. 6/15, B) of its base,

- the external face comprises an angular sector (6/15), on both sides of greater bore point (C), whose radius is advantageously close to that of the receiving chamber in order to favor a peripheral sealing contact of the rotulant type,

- the external face may integrate a crown (41 ten) whose opening direction is opposed to that of the corolla (41 nove) and such that the bore at rest of its larger diameter point (D) is higher than that of the convexity arrow (C) of the aforesaid corolla and that of a narrowing of the receiving chamber (62),

- the internal edge (fig. 6/15, B) of the section base is preferentially circular in order to provide a rotulant sealing contact ensuring a valve effect between the walls (fig. 6/16 & 6/18, 42 quint & 42 six) of its housing groove (42),

- outside upper edge bore is, at rest (fig. 6/17, point 0) most equal to that of the piston.

Each corolla (6/16 & 6/18) is assembled with a certain lateral and longitudinal play in a piston housing (42) comprising on the level of its lower edge a receiving groove (42 quart) of the base or foot of the corolla in order to facilitate the angular torsion movement of the section as well as the rotulant contact of the internal rounded edge (fig. 6/15) of said base with the lower shoulder (42 six) of the groove (42 quart) or its upper conical shoulder (42 quint).

The corolla (fig. 6/16, 41 sept) has the advantage of ensuring a sealing effect during an expansion as well as a radial contraction. This property makes it possible to exploit the relative tolerances of machining piston/room/corolla so that the collar (fig.6/15, C) of the corolla is advantageously in contact with the chamber wall when the piston reaches its course end in its housing (62). For this purpose, the bottom of the chamber (62) is characterized in that it comprises a conical narrowing/contracting (fig. 6/16, A), rectilinear or rounded, such as the machining allowances between piston/chamber be equal or lower to that of maximum bore (fig.6/15, point C) of the corolla when the piston is in end of course.

This provision guarantees a contact (fig. 6/16) between the corolla and the chamber wall (62) as per full closing of the cylinder head, suppressing any leak risk which could result from a delay in expansion of the aforesaid corolla when gas pressure is building.

In order to avoid any introduction risk of dust, sands grains or other impurities likely to scrape the piston receiving chamber, a corolla (fig. 6/16, 41 oct) may advantageously be assembled head-digs with the sealing corolla (41 sept) in order to constitute a scraper corolla such as the generating line at the level of its convexity arrow be in contact with the entry edge of the chamber as soon as the cylinder head is fully closed. The position of this corolla on the piston then ensures the role of stopper sealing the entry of the room (62). In order to avoid any scraping effect on the body of the ammunition, the expert will take care that the bore at the level of the external upper edge (fig. 6/15, point 0) of this corolla (41 oct) be not higher than that of the piston, which does not prohibit that the maximum bore at the level of the convexity arrow be so (few 1/100 of millimetre).

In the case of use of corollas (fig. 6/18, 41 nove) comprising a crown/ring (41 ten), the oversized bore of the latter compared to that of a contracting (rectilinear conical...) (fig. 6/18, A) of all or part of the chamber length (62) provides two functions:

- an initial torsion of the section during progressive engagement of the aforesaid contracting (fig. 6/18, A) by the crown (41 dix) involving an increase in the bore of the collar of the corolla (41 nove) until possible contact with the wall of the chamber (62),

- an increase in the sealing effect by simultaneous contact, at the time of the gas pressure rise, between the generating contact line of the corolla (C) and its crown (D) with the wall of the chamber (62),

- a scraping effect by the crown (41 dix) during piston recoil.

Figure 6/18 presents two corollas (41 nove) with annular rings/crowns assembled one behind the other and separated by a disc (42 oct), the head corolla undergoing, at the level of its crown (41 ten) in contact with the narrowing/contracting (fig.6/18, A) of the chamber (62), a torsion aiming to open it and plate its collar against the chamber wall favoring an immediate sealing. The second corolla not yet having engaged the chamber intake is in rest position. A progressive contracting of the bore at the chamber bottom makes it possible to initiate the mechanical opening of the head corolla only when the piston is in its course end. A suitable dimensioning of the second corolla and in particular of the bore of its crown so that it be in contact with the chamber entry as soon as the cylinder head is fully closed will ensure her role of scraping stopper.

The disc (42 oct) separating two corollas mounted in series advantageously comprises grooves (40 bis) on its periphery to feed the lower corolla with gas in the event of rupture of the first one. The lower edge (42 six) of the corolla housing (42) comprises a conical shoulder (fig. 6/18, 42 nove) favoring some crown (41 ten) play. The assembly of the corollas is made possible with the realization in several parts (or stages) of the piston as indicated on figures 6/16 and 6/18, the upper or head part ensuring the double busc protective role for corollas and segments as well as push rod for cartridges during their introduction.

In order to prevent any variation in adjustment of the axis of the piston with that of the chamber, the corollas are assembled with a certain vertical and side play (fig. 6/16) favoring their perfect centering as soon as they get in contact with the chamber wall.

The assembly side play of the corollas (41 nove) with crowns (41 dix) is at least equal to their bore difference with the piston's (causing the retraction of their contact zone with the ammunition during the cylinder movement) in order to avoid any scraping risk of said crowns on the ammunitions bodies.

Any axial misalignment of the piston is automatically compensated by the rotulant machining of the crowns convex wall ensuring the perfect contact of a generating line with the chamber.

The nature of the invention would not be changed if the profile or generating line of the section of the corolla were different, for example rectilinear or if it would comprise two secant branches or other.

Piston with integrated rotulant corolla (drawing 8/28, fig. 6/19 & drawing 9/28, fig. 6/20):

A simplified realization of the sealing principle per rotulant corolla can be obtained by integrating the base of the corolla (41 eleven) into the lower part (17) of the piston or chuck located behind the head (40 quart) comprising the cartridge basin and the crenels (40 ter) for gas supply. The piston with rotulant corolla can then easily be produced by machining the corolla in the mass of material constituting the aforementioned piston with the characteristics relating to the elasticity of the sole profile of its section:

- the thickness of the aforesaid section decreases regularly, according to a generating line preferentially but not exclusively curve in order to support, under the gas pressure or a contracting of the room (62), a radial elastic variation,
- the external face comprises an angular sector (fig. 6/19), on both sides of the point (C) of greater bore, of radius advantageously close to that of the receiving chamber in order to support a peripheral bore sealing contact of the rotulant type,
- the bore, at rest, of the external upper edge (fig. 6/15, 0) is at most equal to that of the piston.

Any axial shift of the piston with integrated rotulant corolla is automatically caught up by the rotulant part of the external wall of the corolla ensuring a perfect generating contact line with the wall of the chamber.

The corolla of the piston (41 eleven) can also comprise a crown (41 ten) in a way identical to that previously exposed.

Operating Principle

At the beginning of the burst the propellant gases borrow the channels (39, 40), grooves (40 bis), peripheral lights or crenels (40 ter) of the cartridge basin of the piston head (40 quarter) and immediately exert a uniformly distributed pressure (symmetry of said channels, crenels and lights) on the internal wall of the corolla (41 sept, oct, nove & eleven) producing a variation of its curve combined with the torsion of its section (41 sept, oct & nove) involving its uniform expansion and its contact with the wall of the chamber (62) for a perfect sealing resulting from a double action:

- against the peripheral gases around the piston which are blocked by the perfect contact (fig. 6/16) of a generating line (fig. 6/15, C) of the rotulant zone (and, if necessary, of a generating contact line of the crown 41 ten) with the wall of the chamber,
- against circulating gases at the back of the corolla (41 sept, oct & nove), blocked by the valve effect of the rotulant contact of the circular section of the internal edge (fig. 6/15, B) of the base of said corolla playing between the lower shoulder (42 six) of the groove (42 quarter) and its conical upper shoulder (42 quint) according to whether the pressure of gases pushes the corolla to the bottom of the piston or that friction against the chamber tends to make it go up.

As soon as the bullit leaves the barrel the pressure falls instantaneously, the elasticity of the corolla makes it return to its nominal diameter suppressing any risk of piston blocking at the entry of the receiving chamber (62) for the next forwards movement of the cylinder head. In the case of use of a corolla with crown the return to the nominal diameter of the collar occurs only after the leaving of the contracting zone of the chamber by the piston.

Note: When the firing of the ammunition, the recoil of the piston favors the deposit of fatty combustion residues of the propellant on the walls of the chamber which are thus autolubrified. This greasing effect will facilitate the introduction of the piston and will increase the lifespan of the segment.

The expert will adapt dimensions, materials and thicknesses of the corolla to the acting pressures (several thousands of bars) in order to advantageously combine intrinsic elasticity of torsion of the section as well as its curve variation. He will also adapt the number of corollas to be assembled in series one at the head behind the other so as to, if necessary, offer a greater safety in the event of inopportune rupture of the head one.

In order to guarantee a great longevity of the corollas and pistons with integrated rotulant corolla (41 eleven), those will be made out of an elastic material (UE9P, steel, cast iron bronzes...) able to resist the efforts of temperature and friction. A self-lubricating treatment (titanium nitride, Diamond Like Carbon, amorphous carbon, molybdenum, graphite...) may also be applied. In order to increase the intrinsic elasticity of the corolla an annealing of stabilization may be applied in order to solidify the maximum bore at rest with a value lower than that obtained after machining.

The radial elasticity of the corolla acts also as a wear compensator in order to guarantee an always perfect contact of the convex part with the wall of the chamber, in expansion as in compression.

Note: The corolla (41 sept, nove & eleven) may naturally be adopted in all the operating modes (one to seven) described in this patent.

Application: jacks for high pressure and temperature fluid. Spark-ignition engine. This type of corolla may naturally find application in the two or four strokes engines when placed as described, even immediately at the head of piston, in particular according to the simplified formulation (drawing 8/28, fig. 6/19 & drawing 9/28, fig. 6/20) where it can then be directly machined in the head of piston. The bore will be adapted in order to be in permanent contact with the chamber wall. Dimensions, in particular the thickness and the profile curve, will be adapted to the lower compression pressure of the engines. The introduction of the piston into the chamber for the assembly will naturally be carried out by the top of the chamber in order to contract the segment/corolla.

Having no opening, such a segment should appreciably increase the compression output by producing an additional sealing effect to the pressure of gases.

Fifth mode (drawing 9/28, fig. 7/3 & 7/4)

In a fifth mode of mastering the sealing, the piston (fig. 7/3) of the cylinder head chuck comprising a housing groove (42) for a segment or couple of ring seals is characterized in that it is composed of a central sleeve (44) whose front face corresponds to the bottom of the cartridge basin, spring pumps (or bars) (47) positioned out of star around the central axis, an axial ejector/electric igniter (27) and an extractor (22) of ammunition articulated at the sleeve level and equipped with a foot cooperating with the head valve ejector/lighter.

The segment or couple of ring seals (41, 41 bis, ter, quart & quint, sept) is characterized in that its external diameter at rest is such that it remains retracted inside its receiving groove and does not exceed the bore or diameter of the piston.

The central sleeve, composed of two parts supporting the assembly of the segment and solidarized by a pin, comprises two conical stages (45 & 45 bis), the first simultaneously ensuring the gas sealing and the role of course abutment of said sleeve and the conical second (45 bis) one ensuring more particularly the role of compression drawer for the spring-pumps. The housings of spring-pumps (47) are laid out of star around the sleeve (44) housing with which they communicate and emerge on the other side in the housing of the segment (42 bis). The heads of the pumps are resting against the interior side of the segment (a groove being advantageously possibly arranged), their feet simultaneously resting on the cylindrical part of the conical drawer stage (45 bis) of the sleeve. These pumps, once in place, also act as a limiting abutment (anti-extraction) for the central sleeve.

An alternative (fig. 7/5) to the preceding assembly may be obtained by replacing the spring pumps by balls or spigots all around the sleeve (44), especially arranged to this end, in the housing groove o the segment (41) and mounted so as to be simultaneously in contact with a conical stage (45 bis) of the sleeve and the internal side of the aforesaid segment (41).

The sleeve may, moreover, advantageously comprise a second conical stage (45 ter) on which breech/barrel solidarisation paired balls or spigots rest, laid out of star in conical housings preventing any escape of said balls or spigots, the aforementioned housings matching female housings (56 ter) in the receiving chamber of the piston.

The distance between the bottom of the cartridge basin and the forehead of the ammunition chamber may be adapted so that the recoil of the head sleeve (45) occurs at the end of the forwards movement of the cylinder head, the aforementioned head butting against the bottom of its housing under the action of the spring (110). The ring seal (and possibly the breech/barrel solidarisation balls or spigots) are then systematically expelled when the cylinder head is closed.

The adoption of a shorter chuck, with no abutment of the head against the bottom of its housing, will involve a gas pressure operating mode. The expert will take care of the adjustment of the bore of the chamber (62) with the optimal expansion dimension of the segment (41) for the best sealing.

Operating principle

When firing the ammunition (7/3) the propellant gases exert an equivalent pressure at the back of the ammunition and on the head of the sleeve/cartridge basin which recoils inside the chuck/piston contracting then the return spring (44 ter).

The conical stage (45 bis) of the sleeve butts against the symmetrical conical stage of the chuck (17) ensuring the internal sealing of the chuck, as well as the conical shoulder (45) on the symmetrical conical shoulder of the chuck (17), and exerts simultaneously a radial pressure on the spring pumps which compress and cause the uniform increase in the diameter of the ring seal by plating it against the wall of the piston receiving chamber (62) thus ensuring the gas sealing.

Simultaneously the piston moves back (except presence of a mechanical system blocking the cylinder head/barrel) ensuring the delay in chamber opening, the sleeve/basin remaining inserted in the chuck until the pressure of gases stops (chamber opening). As the pressure falls the sleeve/basin comes back to its initial place under the effect of return spring (44 ter). The pumps get back to their initial length under the combined action of the pressure of the contracting segment and the return to the rest position of the conical stage (45 bis) of the sleeve causing a lengthening of the course of said pumps.

The segment then retracts in its housing back to its rest position in order not to exceed the bore of the piston and not to compromise its next introduction into the receiving chamber (62). The electric igniter (27) ensures a quadruple function: sealing, cartridge igniting, ejector and extractor return spring. For this purpose, the extractor (22) comprises a foot resting against the conical part in valve shape of the igniter for its own recoil function.

When the central sleeve is recessing, the spring pumps ensure a quasi-constant pressure of the segment on the cylinder, with no risk of tightening or blocking.

So as to ensure a radial distribution of optimal pressure their number (higher than four) will be adapted by the expert and their length will be such as when the sleeve is inserted and the segment plated against the wall of the cylinder the aforementioned pumps never overshoot their contraction limit.

In order to guarantee a great longevity to the segments, they will be made out of an elastic material (UE9P, steel, cast iron bronzes...) able to resist the efforts of temperature. Frictions of the segment on the wall of the cylinder may be reduced by the adoption of a slightly convex outside (some 1/100 of millimetre) and the application of self-lubricating treatment (titanium nitride, Diamond Like Carbon, amorphous carbon, molybdenum, graphite...) suitable.

This device, in the case of a blowback cylinder head, constitutes a true regulating chamber delay opening system by gas pressure.

The advantage of this formula is to allow the weapon "to digest" a large variety of ammunitions with different masses, without requiring modification of the barrel or mass of the cylinder head, by taking care however to check that the recoil course of the piston be sufficient for the type of ammunition.

In the balls (fig. 7/5) version the recession of the sleeve (44) produces, if the option of breech/barrel solidarisation is retained, a double effect: the expansion of the ring seal and the aforementioned mechanical solidarisation.

When firing of the ammunition the propellant gases exert a pressure equivalent at the back of the ammunition and on the head of the sleeve/basin which recesses inside the chuck/piston by contracting the return spring (44 ter). The conical stage (45) of the sleeve (44) butts against the symmetrical conical stage of the chuck (17) ensuring the internal sealing, simultaneously the conical shoulders (45 bis and 45 ter) exert a radial pressure on the balls or spigots which they are in contact with and cause:

- the uniform increase in the diameter of the ring seal which conforms to the wall of the cylinder (62) of piston chamber thus ensuring the perfect gas sealing,
- the head cylinder/barrel solidarisation by displacement of balls (54) or spigots in the matching housings (56 ter) of the piston.

It should be noted that the balls mechanisms of expansion of the segment and the solidarisation head cylinder/barrel device are dissociable and may be assembled separately or combined with others. In the same way, the expert will appreciate the advisability of substituting the balls by spring pumps for the sealing.

Sixth mode (drawing 9/28, 7/1 & 7/2):

In a sixth mode of sealing realization, the piston comprising a housing groove (42) of a segment or couple of ring seals, is characterized in that it is composed of a central sleeve (44) in two parts whose front face of one (44 bis) comprises the cartridge basin, a star shape expansible disc (7/2, 46) sitting on a stage (45 quart) of the central sleeve, an ejector/electric igniter (27) and an extractor (22) articulated at the sleeve level and equipped with a foot cooperating with the head valve of the ejector/igniter.

The segment or couple of ring seals (41, 41bis, ter, quart & quint, sept) is characterized in that its external diameter is at rest such as it remains retracted inside its receiving groove and does not exceed the bore or diameter of the piston. The expansible disc (46) is conical and its action, once engaged on a stage of adapted diameter, is such that an effort tending to its flatness involves a perfect radial increase in its diameter. The expert will be able to adapt the number of discs as well as the configuration of the segments.

The central sleeve comprises a first stage (45 quarter) seat for expansible disc(s) and a second conical stage (45) simultaneously ensuring the internal gas sealing and the abutment role to the aforesaid sleeve course. The length of the chuck can be adapted so that the recession of the piston head (44 bis) occurs at the end of the forward movement of the cylinder head, said head butting against the bottom of its housing under the action of the return spring (110). The sealing ring is then systematically dilated when the cylinder head is closed. The adoption of a shorter chuck, removing any abutment of the head against the bottom of its housing, leads to a gas pressure operating mode.

The electric igniter (27) ensures a quadruple function: sealing, cartridge ignition, ejector and recoil spring for the extractor. For this purpose, said extractor (22) comprises a foot abutting against the conical part in valve shape of the igniter/ejector (27) so that the return spring of said igniter also provides the function of extractor recall.

Operating Principle

At the time of the firing of the ammunition the propellant gases exert a pressure equivalent on the back of the ammunition and the head of the sleeve which recesses inside the chuck by compressing the expansible disc (46) which increases its diameter and then exerts a radial pressure onto the segment (41).

This latter is plated against the cylinder wall (62) of the piston chamber thus ensuring the perfect gas sealing. Simultaneously the piston moves backwards (except presence of an opening delay system by solidarisation of cylinder head/barrel), the head of the sleeve remaining recessed until the pressure of gases cancels (opening of the chamber). As per this fall of pressure, the head of piston comes back to its initial place under the combined effect of the return spring (44 ter) and expansible disc.

The segment then retracts in its housing towards its rest position in order not to exceed the bore of the piston and not to compromise the next introduction of said piston into its receiving chamber (62).

In order to avoid any tightening and blockage risk of the segment against the chamber wall under the effect of a too fast and important compression of the expansible disc, the return spring (44 ter) may advantageously be coupled with (or replaced by) a stacking of discs the "Belleville" type whose progressive crushing will trigger that of the expansible disc.

In the same spirit, the disc could be designed in a material or in such way that its effort is limited by a buckling of the constituting radial elements in order to ensure a constant maximum pressure value of the segment against the chamber wall. The expert will be careful about the adjustment of the chamber (62) bore with the optimal expansion dimension of the segment (41) for the best sealing.

In order to guarantee a great longevity to the segments, those will be made out of an elastic material (UE9P, steel, cast iron bronzes...) able to resist the temperature efforts. Frictions of the segment on the cylinder wall may be reduced by the adoption of a slightly convex outside (some 1/100 of millimetre) and the application of suitable self-lubricating treatment (titanium nitride, Diamond Like Carbon, amorphous carbon, molybdenum, graphite...).

This device, in the case of a blow-back cylinder head, constitutes a true regulating delay system of the chamber opening by gas pressure.

The advantage of this formula is to allow the weapon "to digest" a large variety of ammunition with different masses, without requiring modification of the barrel or mass of the cylinder head, and by taking care however to check that the length of back course of the piston be sufficient for the type of ammunition considered.

Seventh mode (drawing 9/28, fig. 7/6)

In a seventh mode of mastering the sealing, the breech (17) piston comprises a housing groove (42) receiving an annular and expansible segment (41 six), a central sleeve (44) whose front face comprises the cartridge basin, an electric ejector/igniter (27) and an ammunition extractor (22) articulated at the sleeve level and equipped with a foot cooperating with the head valve of said ejector/igniter.

The sealing ring (41 six) is a closed ring out of metal with known elasticity, its section being trapezoid/isosceles triangle shaped with a summit turned towards the interior and characterized in that its external diameter be at rest such as to remain retracted inside its housing groove and not to exceed the bore or diameter of the piston.

The isosceles sides of the segment are resting against symmetrically arranged faces on the head (44 bis) of sleeve and chuck (17) at the level of the housing groove (42) of the segment in order to produce an expansion of the segment when a compressive force is applied to the aforementioned head of piston. The central sleeve (44) comprises a conical stage (45) and a shoulder at half the height of the housing groove (42) of the segment (41 six) ensuring the role of course abutment of the aforesaid sleeve in order to prevent any crushing or wedging of the ring (41 six) against its support. The electric igniter (27) ensures a quadruple function: sealing, cartridge ignitor, ejector and extractor return spring.

For this purpose, this latter (22) comprises a foot pressing against the valve shaped conical part of the igniter/ejector (27) so that the return spring of the aforesaid lighter also provides the function of extractor return spring.

Operating Principle

When firing the ammunition the propellant gases exert an equivalent pressure at the back of the ammunition and on the head of the piston which causes the expansion of the segment (41 six), absorbing part of the weapon recoil, via the pressure exerted by the couple chuck/head of piston on the internal isosceles faces of the aforesaid segment.

Said segment is then plated against the wall of the piston receiving chamber (62), thus ensuring a perfect sealing effect against peripheral gases from the piston head trapped between contact surfaces of the segment with the sleeve (44) and the chamber (62).

At the same time the piston moves back (except presence of an opening delay system for the solidarisation cylinder head/barrel), the head of the sleeve remaining recessed until the pressure of gases ends. Immediately after this pressure fall, the head of piston recovers its initial place under the combined effect of the return spring (44 ter) and the segment resiliency.

Said segments then retracts in its housing towards its rest position in order not to exceed the bore of the piston and not to compromise the next introduction of said piston into its chamber (62).

In order to avoid, in the particular case of a blow-back option, any tightening risk of the segment against the chamber wall under the effect of its expansion force, the return spring (44 ter) may advantageously be coupled with (or replaced by) a stacking of conical type "Belleville" discs whose progressive crushing will master the expansion of the segment. The expert will take care of the adjustment of the chamber (62) bore with the dimension of optimal expansion of the segment (41 six) for the best sealing.

In order to guarantee a great longevity to the segment, its manufacturing out of an elastic material (steel, cast iron...) able to resist the efforts of temperature will be considered. A self-lubricating heat treatment (titanium nitride, Diamond Like Carbon, amorphous carbon, graphite...) may also be applied, in particular to the isosceles faces of the segment in contact with the sleeve and chuck.

This device, in the case of use of an unlocked cylinder head, constitutes a true regulating system for the delay in the chamber opening by gas pressure.

The advantage of this formula and to allow the weapon "to digest" a large variety of ammunitions with different masses, without requiring modification of the barrel or mass of the cylinder head, and by taking care however to check that the length of back course of the piston be sufficient for the type of ammunition considered.

Note: any combination of modes 1 to 7 previously exposed would naturally enter the field of the invention as any formula aiming at producing the uniform expansion of joints segments for sealing purposes.

The above mentioned modes have also the advantage of being able to be adapted to any weapon using a linear locking for the cylinder head-gun.

DESCRIPTION AND ROLE OF THE CHUCK OF CYLINDER HEAD WITH GAS PORT (DRAWINGS 2 & 3/28)

The chuck of cylinder head is a cylindrical part, cooperating with the cylinder head in which it is housed in order to provide the functions of introduction, igniting and extraction of the ammunition. For machining and assembly/disassembling facility reasons the chuck is provided into two principal elements:

- a body comprising (3):
  - a sealing piston (18) equipped with a basin to accommodate the back of the ammunition,
  - an igniter/ejector (27) unit along the central axis and emerging in the piston basin,
  - an articulated extractor (21) equipped with a hook emerging in the front face of the piston,
  - a push rod of extractor (23),
  - a spring (24) for extractor push rod,
  - a damper (25) plug for igniter/ejector,
  - an electrical insulator (28),
  - an extension (30) of igniter/ejector,
  - housings (56) for spigots (54, 55),
  - gas tubes (40) through the chuck body having a radial direction and emerging in the gas circulation groove (42 bis) concentric to the housing of the ring seal and/or spigots (6 bis) and communicating with channels (39) parallel to the central axis and emerging in the sole cartridge basin,
- a skirt (4 & 5) surrounding the chuck body and including:
  - a housing (42) for a ring seal (41),
  - channels or openings (40) according to a radial direction crossing the piston skirt and emerging in the concentric gas circulation groove (42 bis) to the housing (42) of the segment, located in front of the channels (40) arranged in the body,
  - as required: openings (56) ensuring the role of abutment for spigots (54, 55),
  - as required: spigots (54, 55) for barrel/cylinder head solidarisation during the bullit travel in the barrel.

The chuck housing in the breech is such as the piston (18) be projecting in order to penetrate, during closing cylinder head/barrel, in its housing of the barrel a depth such as, at the time of the firing of the ammunition, the recess of the piston authorise the chamber opening only once the bullit has left the barrel.In order to guarantee a maximum sealing effect to the chamber during the shooting, the igniter/ejector and the extractor emerge into the sole front face of the piston.

Realization modes for the igniter/ejector

The functions of igniting and ejecting a cartridge (either for faulty cartridge or normal extraction) are carried out by a single part: the igniter/ejector (27) which crosses the chuck along its central axis and emerges into the middle of the cartridge basin.

This part presents a valve shape at its head and comprises at its other end a clips engagement groove intended to solidarize a fixing extension (30) onto which abuts a damper (25) plug maintaining the igniter/ejector retracted with its closed valve in the basin. This valve also acts as a contact plug ensuring the electric firing of the cartridge. It stays in permanent contact with the electric source of energy via a connection of the spring plunger type.

Without changing the scope of this invention, the igniter/ejector valve (drawing 6/26, fig.7) recall into closed position may also be ensured, instead of the action of the damper (25) plug on the extension (30), by a spring (29) surrounding the igniter and exerting its pressure simultaneously on the bottom of its housing and said extension (30).

The igniter/ejector (27) is covered with a layer (28) of insulator (ceramic by plasma gun...), rectified by machining after deposit, in order to respect the polarity of the igniting voltage and to prevent any risk of short-circuit.

The nature of the invention would not be changed if the insulator (28) were located in the housing channel of the igniter/ejector. The igniting voltage is exerted between the basin and the head-valve of the igniter/ejector.

Ejection function of the igniter/ejector (drawings 2 to 9/28 & 21/28)

During the backwards travel of the breech, the igniter/ejector extension (30) comes to strike an abutment (77) via a bar (30) causing the opening of the valve involving the ejection of a cartridge which would have been grabbed by the extractor (21).

Temperature resistance of the head chuck / ammunition chamber unit

In order to ensure an optimal resistance against the propellant gases temperature for the ammunition chamber, cartridge basin and extractor, a ceramic treatment by plasma gun projection or equivalent may be applied. This provision also aims at preventing the "cook-off" or auto-ignition phenomenon of the ammunitions during their introduction into the chamber. The integration of a ceramic insert (alumina, Zircon... whose profile matches that of the chamber will lead to an interior entirely out of ceramics and will advantageously delay this phenomenon. The head of chuck, the basin and the extractor could also be subject to a realization out of ceramics.

Realization of the chuck body (drawings 2 to 10/28)

The chuck body is machined in order to accommodate all the elements it contains without requiring any screw assembly. This principle of construction will master the whole conception of the weapon.

Thus, the housing machining in the chuck body of the push extractor rod unit (23), spring (24) and abutment (25) of the extension unit (30) for igniter/ejector presents a semi-cylindrical opening (fig.4, N°50) over a length making it possible to successively insert each element by placing with care in the following order the extractor, the push rod, the pre-stressed spring and the abutment. Then engage the chuck body into its skirt which will solidarize the unit.

The assembly of the igniter/ejector is carried out by its introduction by the basin, with a prior care to grind the valve shaped head in its cartridge basin seat. Once every part has been set up, introduce the extension (30) of the hammer on the stem (27) then solidarize the two parts (27) and (30) using a clips then engage the latter on the abutment (25) if necessary.

In order to guarantee the sealing at the abutment (25) level of the igniter, this one adopts a conical valve profile (fig.6/4, 49) and is maintained closed under the action of the spring (24) of the igniter/ejector extension (30) with which it shares the thrust.

The two parts chuck skirt (fig.5, N°20 & 20 bis) adopts a perfectly machined (thin tolerances) cylindro-conical shape in order to accommodate the chuck body and presents at its base a conical narrowing/contracting (51) intended to cooperate with the bottom, symmetrically conical, of the slide housing. The purpose of this provision is to produce a standard "valve" sealing guaranteeing the absence of hot gases which would reach the back of the slide.

This skirt is in two parts in order to allow the assembly of the ring seal by plunging from the bottom of the chuck without being likely to make it exceed its elastic limit. The expert will be able to carry out the parts 50 and 20 bis in only one block if necessary.

Note: the back of the weapon breech is dead-ended. No opening is present and no risk of hot gas leakage is thus to fear.

The body/skirt connection of the chuck and the chuck/slide one are ensured by any adapted means (pins...). One of these means allowing a fast disassembling may rely on the principle of the break through of the head of a spring plunger, placed in a hole of the chuck, emerging in a specific opening of the slide.

It is enough then, to disunite the chuck of the slide, to press on the head of the plunger and keep it so inserted until the chuck may freely slide out.

GAS OPERATED CHAMBER OPENING DELAY DEVICE (drawing 10/28, fig. 7/7 & 7/8)

A locking of the barrel/slide unit may, on a weapon according to the invention, being introduced in order to obtain an additional delay of the chamber opening. This provision is interesting for weapons whose power of the ammunition would be likely to involve a too fast chamber opening and a propitiatory piston length.

The principle of gas tapping at the level of the cartridge basin, as previously described, can be made profitable here to create an additional opening delay to that produced by the recoil of the piston.

For this purpose, in a first mode of realization, the chuck piston comprises housings for spigots (fig.7/8) radially laid out, communicating with channels emerging in the cartridge basin, which ensure the displacement of the spigots (54) that they contain according to a radial skirt outwards direction, said skirt comprising a conical opening housing limiting the course of each tenon and operating a tight valve type connection.

The piston chamber is characterized in that it comprises female housings (56 bis) of piston spigots heads. These spigots, in a variable number, adopt, preferentially but not limitatively, the shape of sphere (54) or present a flattened base (55) toped by a cone finished by a half-sphere.

When firing the ammunition, the pressure of propellant gases acts on the basis of tenon(s) who immediately penetrate into their respective chamber housings (56 bis), thus blocking the barrel/slide connection.

The fall of pressure registered at the ammunition exit of the barrel causes the pressure cancel at the spigots basis who release the barrel/slide connection for opening the chamber then.

The spigots are free mounted in their housing, their return in unobtrusive position being naturally carried out under the effect of the barrel/slide dissociation.

In a second mode of realization (fig. 7/7) the housings (56) of spigots are radially laid out in the wall of the barrel at the ammunition chamber level in which they emerge directly.

The pressure of propellant gases ensures the displacement of the contained spigots according to an outward radial direction in order to cooperate with a matching female housing (56 ter) machined in the slide to ensure a rigid barrel/cylinder head connection at the beginning of the shot.

The pressure fall at the exit of the bullit from the barrel causes the pressure cancel on the basis of spigots who release the barrel/slide connection for the chamber opening.

The slide is characterized in that it comprises female housings (56 ter) matching with the spigots present on the barrel. These spigots, in a variable number, adopt, preferentially but not limitatively, the shape of sphere (54) or present a flattened base (55) topped by a cone terminated by a half-sphere.

Note: the nature of the invention would not be changed if the spigots, according to any of the previously evoked assemblies, were articulated in any desired way (off-set axis...) or equipped with a return device (spring...).

This temporary solidarisation device for barrel/slide is particularly advantageous in that it ensures an automatic regulation of the opening delay which is directly proportional to the variation of pressure in the chamber, thus at the precise exit moment of the bullit.

This system presents, correlatively, the enormous advantage of an automatic adaptation of the weapon to cartridges of various powers or masses without implying, for a single gauge, modifications of parts.

SHORT BARREL RECOIL MECHANISM (drawing 11/28, fig. 8 & 9)

A mechanism authorizing a short recoil of the barrel, founded on a principle of sliding motion of said barrel in a bedding (107), can easily be obtained, without increasing neither the complexity nor the volume of the weapon.

The barrel (60) is mounted sliding, with a few millimetres course, in its bedding (107) integral with the frame and is maintained in position under the action of a spring shock absorber (110).

This bedding is composed of a hollow roll, with an internal diameter such as to accommodate the barrel, and comprises several guide slots (108) cooperating with matching rails (109) of the barrel.

Two of these rails are horizontally placed alongside the barrel and indexed at 180° one to the other, a third one, if needed, is positioned vertically along the axis and at the bottom of the barrel. The two horizontal rails (109) are advantageously in alignment and of the same format (height and width) with spigots (112) interdependent of the barrel and placed frontward.

The barrel is introduced, mouth first, until the shoulder of the piston chamber butts against the front face of the bedding. The spring shock absorber (110) is then introduced, barrel mouth side first, until butting against the other face of the bedding, then slightly compressed so as to support the assembly of a ring (111).

This ring (fig. 9) cooperates with the spigots (112) integral with the barrel so as to carry out a bayonet type assembly. The ring (110) is then maintained in place by the action of the shock absorber spring (110) which authorizes, simultaneously, a short recoil of the barrel.

This ring ensures the role of course abutment of the barrel and can advantageously be related to the recuperator spring (57) for which it constitutes an ideal seat, facilitating the operations of assembly/disassembling of the weapon.

Note: this system favors a fast change of the barrel and thus the caliber of the weapon by simple adaptation of the cylinder head and magazine.

Barrel short recoil Operation

When firing the ammunition, the gas pressure propels the spigots (55) in their receiving housing (56 bis or 56 ter) of the barrel involving the barrel/slide solidarisation.

The unit moves then back, compressing the only spring shock absorber (110) until the ring (111) butts against the bedding. As per the brutal pressure fall consecutive to the exit of the bullit, the spigots release the slide which sole continues its backwards movement compressing in its turn the recuperator spring (110 bis).

INTRODUCTION OF THE CARTRIDGE

As per all automatic weapons, the ammunition loading system according to the invention is carried out by a magazine (95) whose lips present a cartridge at the entry of the barrel chamber. The piston of the cylinder head ensures this introduction during forward movement of the slide while pushing on the back face of the ammunition to introduce it into the sealing chamber of the piston which acts as a funnel, appreciably improving the quality of cartridges introduction, thus guaranteeing a higher reliability than that of the weapons carrying cased ammunitions.

During this introduction phase, the extractor (21) claw engages the groove at the base of the ammunition to maintain it positioned at the bottom of the basin. The cartridge (1) is then pushed into the chamber until closure of the cylinder head.

Little time before the ammunition course end in the chamber, the extractor claw (21) has engaged, if necessary, the raising slope (59) arranged for said extractor in the barrel. The ammunition is then immobilized in the barrel chamber and its back face is completely resting against the basin of the piston under the pressure of the recuperator spring (57) ensuring the slide closure.

The raising of the extractor is justified only in the case of use of ammunition (pl. 1/28, fig.1/2) whose cap is prolonged at the back in order to protect the propellant. In the case of small calibre ammunition whose extracting groove is an integral part of the solidified propellant, the igniting of the cartridge may occur with an engaged extractor, the propellant being instantaneously turned into gas. A heat treatment of the extractor (nitride titanium), even its covering by projected ceramics will ensure its protection.

DESCRIPTION AND OPERATION OF THE EXTRACTOR RAISING SYSTEM (drawing 2/28, fig. 3)

The extractor (21) ensures the withdrawal of a cartridge from the chamber. Its resistance enables him to support the most violent efforts, in particular in the event of emergency extraction of ammunition for ignition failure. Remember that the design of a caseless weapon without extractor would expose the user in the event of failing ammunition.

The extractor adopts a rectilinear shape (21) made up of a principal arm terminated by an elbow appreciably with right angle at an end. The other end presents the shape of a hook intended to engage the groove of the ammunition. The rectilinear extractor (21) is interdependent of the chuck of cylinder head via a connection using a free locking assembly (3) under the action of a return push rod (23).

This return push rod role is to maintain the extractor in closed or lowered position and, to this end, exerts a couple onto the principal arm.

In order to ensure during the shooting, if needed, the disengagement of the extractor claw from the ammunition groove, the weapon according to the invention is equipped with an automatic means for raising said extractor before firing.

For this purpose, the hook of the extractor ends in an arrow or bevel cooperating with a female housing (59) symmetrically arranged in a bevel, ensuring the role of raising slope (59), placed in the barrel chamber (62). This provision ensures the automatic lifting of the extractor and its disengagement of the ammunition groove as per the closing of the chamber.

The length of the main arm of the extractor is adapted in order to ensure the engagement of the raising slope before the head of cartridge butt against the entry of barrel profile. Thus, the raising of the extractor hook is initiated whereas the ammunition is not completely introduced.

During of a backwards movement, the descent of the hook is simultaneously initiated with the retreat of the slide whereas the present cartridge is still motionless, to be then immediately engaged by the hook for extraction.

The purpose of these raising mechanisms of is to release the cartridge before shooting and to ensure, by simple manual recoil of the slide, the lowering of the extractor and the withdrawal of a cartridge which would accuse some ignition defect for example, to carry out its immediate ejection out of the chamber.

The operation is absolutely identical to that which would imply a traditional weapon, not involving any familiarisation effort or reflex change.

TRIGGER OPERATION (drawings 12 to 14/28).

The trigger actuates, gradually and sequentially via a helicoidal spring machined in the mass guaranteeing an indexing with the perfect neutral, contactors on one or more levels so as to provide the following functions:

- master power,
- semi-automatic fire,
- automatic fire.

In the case of use of only one unipolar contactor on two levels, the first corresponds to the single fire and the second to full auto. In the case of use of two contactors, each one corresponds to a firing mode.
The gunner can thus at will select one or the other of the shooting modes on a simple differential depression of the trigger.

SAFETY MEASURES

The trigger safety (drawings 11, 12 & 13/28)

At the trigger guard level, the weapon integrates a trigger safety or "counter-trigger" (68) characterized in that it be combined with the trigger guard bolt which is composed of a part comprising two arms of which one marries the shape of the trigger guard and constitutes the counter-trigger lever and the other the bolt of trigger guard whose head provides in addition the function of trigger bolt. For this purpose, the arm of the trigger comprises, close to the axis of rotation, a female housing (65) to receive the head or warp end of the bolt (66) of trigger guard.

When disengaged of its trigger housing, the bolt head is resting, under the action of the bolt return spring, on the circular trigger cam (67 bis), thus maintaining the counter-trigger drowned in its housing (69) of the mount of trigger guard. To do so, the cam adopts a circular shape on a portion of angle corresponding to the backwards clearance (shooting) of the trigger.

This cam also comprises a setback (67 ter) on a small angular sector in order to cause, when a pressure is exerted at the back of the trigger, an embossing effect via a short recess of the warp end right before engaging its trigger housing.

The trigger is maintained in "neutral" position under the action of two springs (65) and (65 bis), with equal strength and assembled in contra-rotating direction one to the other in order to guarantee an angular displacement on both sides of a constant neutral position. A sole cylindrical spring machined in the mass would provide the same function without changing the nature of the invention.

A pressure of the finger on the back face of the trigger will cause the locking of said trigger by engagement of the bolt head (66 bis) of the trigger guard in the matching trigger housing (67) and the simultaneous appearance, in the trigger guard, of the counter-trigger arm (68).

A forwards pressure from the index on the counter-trigger arm will cause the disengagement of the warp end of the trigger guard bolt out of its housing, releasing the trigger towards its neutral position under the action of its return springs. The weapon is then immediately ready to fire.

This safety offers four advantages:

- its operating principle mobilizes the sole trigger finger which, since it acts on the counter-trigger, cannot simultaneously exert parasitic action on the trigger itself and cause an inopportune departure as it happens on weapons equipped with safety levers easy to handle by another finger.
- its implementation is completely ambidextrous and is quickly carried out with only one hand, guaranteeing a user wounded at a hand to emerge from a perilous situation.
- its principle avoids any miscoordination, in particular in the event of stress, since it requires only one and single finger to actuate the safety and fire.
- its safety formula of the only one to remain permanently engaged and to be released a split second before a shooting reflex.

Accidental departures are thus impossible.

Note: the trigger guard bolt authorizes the swing of said trigger guard around a common axis with the magazine stopper. The trigger guard comprises an abutment (78) limiting the backwards course of the slide. The cancelling, during the swing of the trigger guard, of this abutment allows the complete retreat of the slide which can then be disengaged from its guide rails of the frame to carry out the disassembling of the weapon. When opening the trigger guard, the bolt is operated by traction towards the barrel mouth, the counter-trigger arm moves then until the bottom of its housing (69), machined to this end, in the mount of trigger guard.

CHAMBERED CARTRIDGE INDICATOR

The weapon is equipped with a cartridge presence indicator in the barrel chamber. This provision is particularly important whereas rare are the models equipped with this essential safety device.

For this purpose, the weapon uses the measurement of a very weak tension between the two igniting poles constituted by the contact pin and the cartridge basin, testifying the presence of a conductor such as the cover of the ammunition. This current can be made profitable to generate a signal to the screen located at the back of the weapon slide or the lighting of a diode, with adjustable light intensity.

DATA TRANSFER BETWEEN FRAME AND BREECH (drawing 27/28).

The reciprocating motion of the breech/cylinder head to the frame involves the need for transferring information and electric power between the central processing unit and the trigger.

For this purpose, the recuperator spring (57) is characterized in that it is doubled by one or more conducting wire contained in a sheath (thermocontracting type) surrounding said spring wire and indexed at its two ends, namely the barrel bedding and the cylinder head, in order to ensure a tight multipolar connection between the information wire routing from the trigger (fig.29, N°125 quart) and from the central unit of the cylinder head (29, N°125 ter). The steel wire composing the spring ensuring an electric polarity between the cylinder head and trigger block.

LARGE CAPACITY TANDEM MAGAZINE (drawings 15 to 20/28)

The advantages, out of common appreciation in term of volume reduction (50%) allowed by the caseless ammunitions, can be made profitable to appreciably increase the number of cartridges one can reasonably place in a magazine. A length of about 20 m/m overall is from now on possible for a 9 mm ammunition instead of the normal 29,5 m/m, for example.

This length reduction makes it possible to naturally position two tandem raws of ammunitions in the volume of a traditional magazine without appreciably increasing its overall dimensions. The positioning of two cartridges in tandem according to the invention would occupy a volume of only about 45 to 50 m/m, an easily integrable length in a handle gun.

The model of magazine (14 to 18) according to the invention is thus founded on the principle of two tandem (97 & 98) compartments containing each one a stacking of cartridges laid out in one, two or in three piles. These compartments cooperate via common lips (96) intended to forward the ammunition to the barrel feeding ramp and are sequentially initiated by a coupling device.
Each compartment conveyer comprises one or two buttons (101), as required, sliding in a corresponding vertical groove arranged on the side faces of the magazine. A finger (thumb) action on a button ensures the manual descent of the conveyer for cartridges feeding.

The button of the front compartment conveyer cooperates, when reaching its course end, i.e. when the last cartridge leaves the lips of the magazine, with the coupling device of the compartments for a continuous feeding of the weapon.

Compartments Coupling Device (drawings 17 to 20/28, fig.19 to 22)

The coupling compartments device ensures, during the rise of the cursor or button (101) of the front compartment, the swivelling of a cartridge stopper (103) which releases the cartridge of the aft compartment. The head cartridge of this compartment comes then immediately, guided by the lips of the charger, to butt against the cylinder head, ready for introduction into the chamber.

The main arm of the cartridges stopper (103) comprises at its end a horizontal abutment (103 bis) intended to prevent, when the magazine is engaged in the weapon, the cartridges of the aft compartment to reach the lips level to be pulled by friction at each passage of the cylinder head, is articulated on the back wall of the magazine well via an axis crossing the frame:

- either in a perpendicular way to the barrel axis in order to ensure a backwards swivelling of the stopper which then comprises an locking-arm (103 ter) equipped at its end with a pin (102 bis) to co-operate with a locking hook (102). The stopper returns into front or projecting position (20) under the action of a spring (104) located in the recess housing of its angular displacement.

  It is maintained locked in this position by the action of the hook (102) immobilizing the locking-arm. The aft swing of the cartridges stopper is ordered by the opening of said hook (drawings 17 to 20/28, fig.19 to 22, N°102).

  This hook, linked to the frame wall via a rotation axis, cooperates with the pin (102 bis) located at the end of the locking-arm and comprises, in addition, a cam (102 ter) cooperating with the button of the front conveyer.

  When the last cartridge of this compartment leaves the lips of the magazine, the conveyer lift up causes the button to exert a pressure onto the cam involving the swivelling of the hook. The button continues to exert its pressure on the locking-arm involving its backwards swing. The cartridges of the aft compartment are then released. When the magazine is disengaged, the spring return force (104) of the stopper is enough to ensure the re-engagement of the locking-arm pin by the head of the hook involving, in turn, the re-locking of said stopper.

- either in a parallel way to the barrel axis in order to ensure a lateral swivelling of the stopper-arm (103) and its horizontal abutment (103 bis) initiated by the rise of the front conveyer button (101) who, as soon as the last cartridge leaves the compartment, causes the swing of a transmitting rod housed in the internal side wall of the magazine well and mounted swivelling on its median axis to cooperate with an arm integral to that (103) of the cartridge stopper to involve its lateral swing. The stopper and the transmitting rod comprise each a return spring ensuring their return into position as per any magazine disengagement. The presence of a stopper hook (102) cooperating with the transmitting rod is not essential since the force exerted by the cartridge on the horizontal abutment (103 bis) passes by the central axis of the stopper and generates no couple justifying a mechanical blocking device excepted, possibly, the prevention of an inertial shock.

Triple cartridges stacking capability for magazine compartments (fig. 15, 17 & 18)

In order to appreciably increase the fire power of the weapon, a three columns stacking of the cartridges can easily be obtained with appropriate dimensioning and geometry of the cartridge wells of each compartment.

Indeed, the cartridges lift up, under the action of the conveyers driven by their respective springs, without wedging to ensure the presentation of a single one at the magazine lips, requires that the wells adopt a rectilinear profile from the base up to a certain height and terminate in a narrowing at their top. This narrowing is characterized in that it is dissymmetrical in order to modify gradually, as per the progressively rise of the cartridges in the well, their stacking from three to two, then to become a single column pile with the resulting pressure exerted on any cartridge by all others be not normal to its compartment side wall. This dissymmetry is obtained by adoption of a particular and different slope angle for each sidewall (95 bis & 95 ter) making the narrowing part of the magazine.

The slope dissymmetry of the magazine sidewalls can be easily obtained in a plastic material (or suitable resin) realization of the magazine that would let no external dissymmetry appear or by an adequate embossing (18 & 19) of the side wall of each compartment in the case of a metal manufacturing.

This disposition makes it possible to easily feed each compartment with twenty cartridges, carrying up to more than forty rounds the fire power of the weapon. A lengthened magazine would easily allow boosting the number of cartridges up to twenty five or thirty per compartment.

Counter-recoil cartridges abutment

During the aft movement of the cylinder head, the counter-recoil function for the ammunitions of the front compartment is automatically carried out by the central wall between two compartments.

As a matter of fact, when the magazine is engaged, the head cartridge is a few millimetres recessed down by the cylinder head. Its plane back side then butts against the central wall if the friction caused by the back movement of the cylinder head tends to make it move backwards.

This function is similarly provided by the cartridge stopper and the height of the back wall of the well for the ammunitions of the aft compartment.

Note: When the front compartment is empty, the upper position of the conveyer, determined by an abutment integral to the magazine wall, may slightly exceed the top of the central wall in order to keep the last cartridge pressed against the lips of the charger, constituting then a perfect feed ramp for the back compartment cartridges.

Those are then guided in the tunnel constituted by the lips of the charger and the conveyer, which they slightly press down during their transit, for an immediate introduction into the chamber under the push of the piston of cylinder head.

Capacity limitation device of the back compartment (drawings 15 & 16/28, fig. 14 to 17)

The model of magazine according to the invention implies that, once engaged in the weapon, the sole front compartment cartridge is in upper position.

If the design of the magazine would not authorize, aft compartment full and front one furnished with at least a cartridge, the descent a sufficient height of the back pile of ammunition by the cartridge stopper upon said magazine engagement, a capacity limitation device of this compartment may be set up.

This device advantageously exempts the users from counting a maximum number of cartridges to be supplied in the back compartment to allow the descent of the pile of ammunitions under the stopper action.

For this purpose, it is composed of a bolt, automatically erasable during the introduction of the magazine into the weapon well, limiting the capacity of the compartment to the maximum number of cartridges minus one. This bolt prevents the conveyer of the compartment from completely going down and authorizes the full course only once erased.

To do so, the central wall (98 bis) separating the front and aft compartments integrates, in its plan, a housing for a short bar (106), sliding laterally in said housing in order to let exceed a bevelled (or round) strip out of the side wall of the magazine.

The central wall also comprises a longitudinal rail or slit (98 ter) in its center intended for the sliding motion of a pin (100 bis) located on the front face of the back compartment conveyer. The strip of the bar is maintained protruding under the action of a spring (106 bis) and cooperates with the internal wall of the well which ensures its recession during the engagement of the magazine. The bar adopts preferentially but not limitatively a trapezoidal section in order to slide in the symmetrical section of the central wall housing.

The bar comprises a receiving slit (106 ter) for the pin (100 bis) of the back compartment conveyer. The slit is positioned in such a way that it can only be engaged by the pin when the supporting bar is lowered, i.e. when the magazine is engaged in the well. This device prohibits the feeding of the magazine beyond of a certain number of cartridges for, recession of the protruding part of the abutment during the complete introduction of the magazine obliges, authorize a further descent of the conveyer.

This action favors the cartridge stopper's which causes the descent of the pile of cartridge a length compatible with the passage of the cylinder head for the exclusive feeding of the weapon with ammunitions from the front compartment.

In order to facilitate the realization of a magazine according to the invention, the central wall may be removable and positioned by guiding rails on the internal walls. Another mode of realization may be obtained from buckled then folded and welded metal plate.

Magazine feeding and operations

The cartridges supply of a magazine according to the invention may indifferently by initiated with any compartments.

Shooting training, by short bursts or with a limited number of cartridges requiring only one compartment, will be preferentially practiced with a loaded back compartment.

As a mater of fact, this one is the sole whose conveyer's button commands the breech arrester (indifferently mounted on the right or left side of the weapon). The use of the front compartment would lead to a breech closure on an empty chamber. The introduction of a breech arrester raised by the front compartment pin, for the preferred use of this compartment, is naturally possible but would involve an interruption of the firing sequence of both compartments.

The feeding of each compartment will be easier than with the traditional magazines because of the perfect linear surface of the ammunitions. Indeed, the traditional ammunitions comprise a lip at the level of the case/bullit junction which causes a scraping effect on the preceding case during the introduction of the cartridges.

The introduction of ammunition into the back compartment will, moreover, be facilitated by the presentation, head first, of the ammunition.

BREECH ARRESTER (drawing 21/28, fig. 23).

To ensure ambidexterity, the breech arrester or slide stopper (78 bis) of composed of a lever whose assembly can be indifferently installed on one side or the other of the weapon, or be present simultaneously on both sides thanks to a second lever, at user's preference.

In the case of a simultaneous assembly of both arresters those are interdependent one with the other via an axis crossing the frame. The levers are indifferently upwardly actuated by the aft transporter button (101) present on both sides of the magazine. Remember that it is still possible to actuate the arrester with the front conveyer button after opening of the hook (102) locking the cartridges stopper (103).

This provision allows the indifferent use of front and aft compartments, but involves however a blocking of the cylinder head in aft position during a continuous firing sequence consuming the front and aft compartments cartridges. A manual recess of the cylinder head will allow resuming the fire sequence with the introduction of the first cartridge of the back compartment.

A receiving notch for breech arrester is arranged on each side of the slide. However, in the case of simultaneous assembly of both stoppers, a single one owns a capture tenon: this provision ensures the systematic release of the slide, under the recuperator spring action, at the time of a pressure on any of the levers.

FULL AUTO MODE

The former description relates to the semi-automatic operating mode of the weapon, i.e. each round firing must result from a complete and continuous pressure of user on the trigger. Under full auto mode, the weapon must be able to fire continuously as long as the trigger is not released.
For this purpose, the igniting voltage is delivered to the firing pin according to a rate/rhythm sequenced by the clock under central processing unit control. To do so, the weapon can be connected any time, via its special port, to a computer to program the central unit memory with the firing parameters, in particular the rate of fire as well as the rounds limiter allowing for selective firing from single to two or more rounds per burst, up to full auto.

WEAPON RECOIL COMPENSATOR (drawings 10/28 & 12/28, fig 7/8 & 10)

The counter barrel raise due to weapon recoil during full auto firing may be obtained by gas tapping at the level of the ammunition chamber, said gases being evacuated at the barrel end with an upwards direction.

The principle of caseless ammunitions favors a gas tapping directly at the chamber level whereas the presence of cases on traditional ammunitions makes it quite simply impossible.

The device is composed of a vertical gas port (90), bored through the upper wall of the barrel at the entry of the ammunition chamber, communicating:

- either with an assembled side-mounted tube emerging at the top end (the cylinder head is arranged consequently and comprises a female housing for this tube).

- either with a channel (fig.10, n°92) bored longitudinally in the slide wall alongside the barrel and emerging at its end according to an upwards direction. The slide opening adopts the shape of a groove (91) practiced on its internal face with a favourable length to support the gas supply during the back travel of the breech. This provision makes it possible to feed with propellant gas the ramp thus created in the slide and this from the ignition till the opening of the cylinder head.

When firing an ammunition, part of propulsion gases escape by the opening of the chamber and travel along the slide via the ramp or the tube to emerge vertically at the end of the weapon.

These gases produce a vertical push, instantaneous and in symmetrical progression of the propulsion force of the bullit, countering the progressive raising of the weapon consecutive to the recoil produced by the departure of said bullit. A smart dimensioning of the openings and ramp for gases should ensure a perfect stability of the weapon during a full auto fire.

This compensating formula is the only one to guarantee a perfect synchronization of the counter-raising action with the bullit departure in order to counter the recoil at best.

KEY LOCKER (drawings 21 & 22/28, fig. 23 & 24)

The weapon comprises, in order to guarantee the use by its sole owner, a key device (23 & 24) prohibiting shooting, magazine engagement/disengagement and weapon disassembling. This device is composed of a reduced size removable locker (114), made out of strong metal, which comes in a housing (113) located on the lower face of the frame in front of the trigger guard.
This locker crosses the frame to emerge under the barrel and ensure the following quadruple role:

- abutment for the cylinder head course between the locker head and the lower front edge of said cylinder head in order to prevent any introduction or extraction of cartridge,

- counter-trigger locking,
- command of the magazine well locking rod,
- locking of the weapon disassembly bolt (trigger guard).

The installation of this locker is only possible when the trigger safety is engaged, thus involving the appearance of the counter-trigger and the simultaneous displacement of the corresponding bolt. This recessing of the bolt releases the opening of the housing (113) for the locker as well as the warp end (115 bis) located at the end of the locking rod (115) of the magazine well who emerges in said housing.
This rod, maintained in position by its return spring, crosses the weapon frame in such a way that its other end emerges in the magazine well under the effect of the displacement generated by the pressure of the locker body on the warp end during its introduction into the housing. The rod then engages the corresponding hole arranged in the wall of the front magazine compartment or, failing this, prohibits any magazine introduction.

The installation of this locker, made up of two coaxial parts whose dissociation can be carried out only with the key in closed position, ensures the implementation of four safety measures:

- trigger locking resulting from the preliminary and compulsory installation of the counter-trigger bolt before introducing the locker into its housing,
- cylinder head locking resulting from the introduction of an abutment (head of lock) limiting its course and prohibiting any chambering of cartridge,
- magazine well locking resulting from the displacement of the rod (115) preventing any withdrawal or introduction,
- weapon dismantling by immobilization of the trigger guard bolt.

MONOBLOC AIMING DEVICE (drawing 23/28)

The slide of the weapon, according to the invention, comprises an ejection window for ammunitions on the sole lateral right side without encroaching on said slide.
Such a distribution is possible thanks to the use of caseless ammunitions contrary to traditional ammunition which impose, on the others weapons, an oversized ejection port encroaching on the top of the cylinder head.

This specificity can be made profitable to equip the weapon with a monobloc aiming (25) device composed of a solid cast rail (117) with a U section comprising a front sight at an end, integral with the slide by a pin (122) bored through said slide at the frontsight (120) and by a part ensuring a connection (119) between a thumb screw integral with the slide and said rail, the aforementioned part comprising a vertical axis (123) crossing said slide to engage a hole arranged on the lower face of said rail, which hole communicates with the housing of a circlips dish (121) which, set up, engages the axis (123) groove for locking.

This aiming set can advantageously be painted, in the inside of the rail and all over its length, with suitable color so as to facilitate the reactive shooting. It ends with a frontsight located in the rail prolongation and is painted with a different color on its user's profile side, so that this latter benefits from an immediate appreciation of the elevation to adopt. For this purpose, the aiming control is facilitated by the simple adjustment of the handlebar (120) portion to let emerge in the center of the U shaped rail. This latter is underlined of white painting to facilitate the visual acquisition.

The angular adjustment is carried out by a micrometric screw (118), located at the top and inside the breech, perpendicular to the symmetry plan of the weapon, which cooperates with the part (119) integral with the aiming rail. This part (119) is composed of a body in which the endless screw circulates, surmounted by a vertical axis which crosses the upper wall of the breech and is fixed to the aiming rail. In order to take into consideration the radius of curvature during the swivelling of the rail for an adjustment, the opening for the axis of the connecting part (119) presents the same curve centered the same (122) as that of the aiming rail.
The thumb screw is cylindrical shaped supporting endless threading and comprising a receiving slit for a screwdriver head at its emerging end, the other end, placed in a housing of the slide, is equipped with hemispherical housings on the circumference of its plane face to receive the ball head of a spring-pawl (118 bis).

The spring pawl is housed in the slide body, its axis parallel to that of the screw, and in such a way that its head emerges in the receiving hole of the screw and be resting against its side face in order to proportion the aiming correction.
The screw (118) is free assembled in its housing and comprises circlips positioned inside the cylinder head in order to maintain it in its housing.
The connecting part (119), driven by the thumb screw, ensures the angular displacement of the aiming rail.
The head of the flat circlips (121) may advantageously bear the underlining of white painting of the rail entry.

Note: the connection of the vertical axis (123) of the connecting part (119) with its dead-opening in the rail may, without changing the nature of the invention, be screw-type or benefit from the possible elasticity of the material composing the aforementioned axis to ensure the connection by reversible clip.

TELESCOPIC BARREL (drawing 24 & 25/28, fig. 26 & 27)

The weapon according to the invention may incorporate a telescopic barrel intended to increase the firepower, the precision and range of the caseless ammunition.
This device is composed of a telescopic barrel (138) with automatic extension mounted sliding inside a second barrel (140) and maintained in a retracted position by a return spring (141). The internal barrel (138) presents the shape of a hollow roll whose internal diameter is adapted to the caliber of the ammunition and comprises two contiguous and coaxial sections (138 bis) and (138 ter) with external diameters ready to cooperate respectively with the diameters of the interior shoulders (140 bis and 140 ter) of the external barrel (140) inside which said internal barrel slides.
The two barrels are encased one in the other so as to carry out a sliding telescopic assembly thanks to a contact flange constituted by the larger diameter cylindrical part or stage (138 bis) of the internal barrel (138) in contact with the larger internal diameter cylindrical part of the external barrel (140 ter) and the smaller diameter part (138 ter) of the internal barrel in contact with the inner wall of the small diameter cylindrical part or stage (140 bis) of the external barrel.
The fitting of the parts in contact is likely to support a tight connection with the minimum of frictions. The internal barrel may be rifled on its interior cylindrical part as per the majority of guns.

The connection between the two barrels is likely to authorize an axial sliding and prohibit any free rotation of a cylinder compared to the other. For this purpose, the external surface of the internal barrel is characterized in that it comprises on its lower diameter (138 ter) part a certain number of rectilinear or helicoidal grooves cooperating with symmetrically arranged grooves on the internal face of the cylindrical part of lower diameter (140 bis) of the external barrel with which it cooperates.

The end of larger internal diameter of the external cylinder (139) comprises an external threading intended to cooperate with a matching threading arranged in the bedding (107) of the weapon. A pin locks the barrel-bedding connection.

A return spring (141) intended to ensure the return into retracted position of the internal barrel is emprisonned between internal and external barrels. Surrounding the internal barrel (138 ter), its both ends rest against the radial faces (138 bis and 140 bis) of each stage of the internal and external barrels.

In order to prevent any deterioration of the return spring during the compression produced by the extension of the internal barrel, the external cylinder comprises an inner setback or shoulder (142) against which the front face of the large diameter cylindrical part (138 bis) or stage of the internal gun comes to butt at its course end.

The assembly of the unit is particularly simple and easy: engage the recuperator spring around the internal barrel (138) then introduce the unit into the external barrel (140) which one then screws in the housing of the bedding (107).

The back face of the internal barrel emerges in the chamber of ammunitions and comprises a conical funnel-collector (143) intended to accommodate the bullit.

This funnel has an entry diameter close to that of the internal diameter of the external barrel in order to suppress any gas pressure which would tend to be exerted alongside the barrel axis and push the aforementioned telescopic barrel outside and increase unnecessarily the weapon recoil.

Telescopic barrel operating principle (fig. 26 & 27)

When firing the ammunition the bullit is propelled in the conical collector (143) of the telescopic gun (138) whose frictions with said bullit involve a transfer of energy causing its progressive extension (27).

The projection of the telescopic barrel appreciably increases the dimension of the cartridge chamber for a better propellant combustion as wall as an increase in the duration of propulsion and guidance of the bullit: the power at the barrel mouth is increased in similar proportions to that produced by a traditional increase of the barrel length.

The telescopic barrel extension occurs simultaneously as the cylinder head recoils, compensating thus the recoil with a forward projection of mass in due proportion of the telescopic barrel mass and its exit speed. The telescopic barrel thus generates an anti-recoil effect favouring the fire stability, particularly in full auto.

As soon as the bullit exits the telescopic barrel, this one returns into retracted position under the effect of the return spring, ready to accommodate a new bullit.

ADVANTAGES OF ELECTRONICS IN the WEAPON (drawings 26, 27 & 28/28)

The introduction of electric power and microprocessors leads to a simplification of the mechanisms, therefore a weight reduction, and to the integration of particularly important new functions:

- detection of a cartridge in the barrel chamber,
- selection between single and full-auto fire from the trigger,
- selection of the number of shots fired during full-auto burst,
- cartridges counter,
- number of shots per accredited user,
- total shots counter (barrel wear),
- clock: date and hour of the shootings,
- recording: the central processing unit comprises a memory size making it possible to restore all the elements of a shooting (user, date & hour, a number of shots...),
- fire safety with automatic fingerprint recognition of the accredited(s) user(s),
- authorized users registration,
- automatic control of the type (short, long...) of magazine engaged in the weapon,
- low batteries alarm.

FIRE SELECTION (drawing 26/28)

A fire selector (81) with two positions "S" (for single or shot by shot) or a pictogram representing a cartridge and an A or AUTO (for automatic) or a pictogram representing several cartridges, can be installed on one of the side walls of the handle in order to guarantee the user the absolute control of burst shooting.

This selector may integrate several additional positions corresponding to the number of shots during a burst. This number of ammunitions may be indicated by the affixing of a number or as many stylized cartridges around the selector. The single position will inhibit the function of any second contactor or the fully depressed position of any two levels contactor of the electric trigger.

In the case of burst firing, the trigger being fully depressed, the registration of breech effective closure by a standard micro switch contactor (128), optocouplor... located, for example, at the frame/breech junction (28) will be compulsory before delivering of the required voltage to the igniter/ejector. A three positions rotactor whose axis would be confounded with the trigger one would provide the same functions without changing the nature of the invention. The fire selections are carried out then by a progressive pressure applied on the trigger, suppressing the need for a selector (81).

FUNCTIONS DISPLAY

The weapon comprises a display screen for the following informations:

- cartridge presence in the chamber,
- cartridge counter,
- fire clearance,
- selection: single or burst,
- time & date,
- accredited users name (or codes),
- battery.

In order to have essential information (authorization of shooting, numbers of remaining cartridges, fire selection) the display screen will advantageously be located (fig.29, N°132) at the back of the breech of the weapon, just below it aiming sight, in order to be permanently visible when the weapon is in its holster or, in particular, in line of sight before a shooting.

A micro push-button will allow for the selection of the various functions at the screen.

SHOOTING RECORDING

The electronic circuit of the weapon comprises a clock and a memory whose information is displayable on interrogation via a port, located inside the breech, for connection to a computer, said port being accessible after introduction of an empty magazine in its well and said breech having been pulled backwards (causing its blocking in aft position).

The retrieval of this memory makes it possible to restore all the elements of employment of the weapon:

- date & hour of the shootings,
- selection (single or burst),
- user identity,
- number of fired ammunition,
- date & hour of users accreditation,
- total of fired ammunitions over a period (e.g. year),
- statistics (barrel ageing, .).

Cartridges counter (fig. 28 & 29)

The knowledge of the number of remaining cartridges in a weapon has always been crucial information for the user. Still today, the absence of counting system obliges the user to a differential computation between the consumed cartridges and the initial capacity of the weapon in order to determine the number of remaining ammunitions.

In order to ease the determination of the number of remaining cartridges, the weapon integrates a cartridge counter device by registering the presence of a cartridge in the chamber and the knowledge of the position of the front and aft conveyers of the magazine.

The use of an incompletely loaded magazine having no possible justification unless for training purposes, it is thus enough to know, for an operational use, the upper or lower position of each compartment conveyer to deduct the number of remaining cartridges prior to shooting.

For this purpose, the magazine well is equipped with contactors (130, 131) located inside the frame at the top and bottom of the motion sliding groove of each button of conveyer.

The information of position of each button thus collected is transmitted to the central microprocessor which assigns a value, contained in its memory and abounded of the detection of a possible presence of cartridge in the barrel, reflecting the total capacity of the weapon. The distinction between various models of magazines (short, long...) follows the same principle: a contactor (129) located in the weapon magazine well allows the central processing unit calculation, if actuated, to identify the type of magazine and to display the information relating to effective capacity according to the conveyers position and the information of presence of a cartridge in the barrel.

For each shooting the central processing unit substracts an ammunition to the computed total and carries the result to the screen. This method, inexpensive in term of production, does not make it possible however to know the instantaneous capacity of a partially furnished magazine engaged in the weapon.

For this purpose, the magazine well may integrate a sensor scale to detect the passage of a marker (magnetic, electroluminescent...) located on the conveyer of each compartment. Spacing between each sensor corresponds to the displacement of the conveyer during the withdrawal of a cartridge from the corresponding compartment.

The referencing of the position of each sensor will make it possible the central processing unit to determine the capacity of each compartment and abound it of the possible presence of a cartridge in the barrel to establish the instantaneous capacity of the weapon.

Note: the number of shots may be determined by the number of discharges actually entered to the igniter (no electrical contact in the absence of cartridge).

BIOMETRICAL IDENTIFICATION

In order to authorize shooting only to authorized weapon owners or duly accredited persons, a fingerprint recognition device is incorporated to the central block (133) located in the breech, behind the cylinder head (124).

This device is coupled to a substrate (123), ensuring the detection or analyze of the print characteristic points, applied to the front face of the trigger.

The system is activated only when the counter-trigger safety is de-activated, causing a slight recess of the trigger which comes to press the master power switch (125) of the weapon circuits, located behind the trigger near the single (126) and full-auto (127) fire switches. The identification module is then under tension and its role and to authorize the shooting after a positive identification of the user fingerprint.

Note: the master power switch of the weapon and the single fire contactor may advantageously be integrated into a two levels contactor or in a rotactor (125 bis).

Accreditation Procedure

In order to ensure a control and a permanent follow-up of the users (individuals, administrations, armed forces, special forces...) an accreditation procedure or memorisation of the fingerprints is established according to a two levels principle of accreditation.

For this purpose, the memory size of the block of identification is divided into two compartments of which one (136) is reserved for the recording of the prints of the entitling people and the other (135) with that of the competent people.

First level

This level corresponds to that of enabling private individuals by the only proper competent authorities to carry out accreditations of use of a weapon. This operation is made impossible for any user who would not have been designated as such.

For this purpose, the identification block memory compartment (136) is accessible only by one port (137) located inside the breech of the weapon and the memory saving of the desired prints is carried out after the unlocking of the access to said memory via a software (PC) and a special connecting cable.

This software unlocks, via a code, the access to the compartment report during a lapse of time (a few minutes) sufficient to allow the user accreditation.

Accreditation procedure:

- withdraw the weapon locker for complete unlocking,
- withdraw the magazine and check that no ammunition is present in the chamber,
- pull the breech back and lock it with the arrester,
- connect the cable to the computer via the port located inside at the back of breech,
- initialize the unlocking software and enter the authority access code then the name and the identifying code of the person to be entitled.
- await the weapon unlocking confirmation signal (sound),
- check the counter-trigger is unlocked,
- affix the finger of the person to be accredited on the trigger,
- wait for the of end of accreditation signal (sound),
- disconnect the wire from the port of the breech,
- the weapon is now usable by new the accredited person only.

Note: this procedure, which may be used by the administrations in their buildings (police station...) is particularly adapted to the diffusion of the weapon via the traditional distribution networks (arms manufacturers...), where the personal code of the future weapon owner is directly and beforehand addressed by the administration.
The sole accredited person (excluding any other) can then use the weapon. A validity period may be introduced in order to require the user to periodically stop by the authority services to unlock his weapon.

Second level

This level allows the transfer of habilitation from an authority known as "entitling" towards an end user via a simplified procedure, requiring no wiring between the weapon and the computer in order to be quickly performed in operations. No capacity of transfer of the accreditation is then allotted to new the ability.

Quick accreditation procedure:

- withdraw the weapon locker for complete unlocking,
- withdraw the magazine and check that no ammunition is present in the chamber,
- unlock the counter-trigger,
- initiate a sequence by carrying out a preset number (for example five) of complete and successive pressures on the trigger,
- affix the finger of the entitling person on the trigger,
- await the authorization signal for accreditation sequence (sound),
- in the next XX seconds (for example thirty, the authorization sequence stops after) affix the finger of the new user during five seconds on the trigger,
- the emission of a new signal (sound) confirms the new user accreditation (only one possible) and the opening of a new accreditation sequence,
- the absence of fingerprint on the trigger during an accreditation sequence closes it automatically.

The weapon will be only usable by the entitling person and those who have been entitled.

Note: this secondary accreditation procedure is discretionary. Only the concerned administrations will benefit from this fast enabling possibility whose implementation is carried out via a specific code delivered by the manufacturer.

RESISTANCE TO ELECTROMAGNETIC FLASHES AND OTHER INDUCTIVE CURRENTS

The weapon according to the invention must be capable of irreproachable operation whatever may be the environmental conditions (violent storms, strong radars radiation, nuclear electromagnetic flashes ...). For this purpose, necessary shielding of the vital elements (central processing unit, identification memories block ...) will be adopted in order to guarantee a perfect insensibility to these phenomena.

ADVANTAGES OF THE WEAPON AND THE AMMUNITION ACCORDING TO THE INVENTION

The weapon and the ammunition according to the invention carry many advantages compared to the current solutions, in particular in term of precision and fire power. These advantages are indexed as follows.

Precision

The barrel is either assembled fixed ,rigid, or sliding in its bedding removing de facto any problem of repositioning between each shooting as per the majority of the weapons in service.
The telescopic barrel device also adds of this precision by offering guidance lengthened travel to the ammunition.

Safety

A higher reliability compared to that of the weapons with cased ammunition whose base is protruding outside the barrel chamber during firing, exposing the gunner to a burst risk of the case and primer wall. This patent, on the other hand, rests on a principle of drenching the ammunition into a tight sealed and confined chamber with the benefit of the walls thickness of the barrel and the sealing piston.
Trigger safety, made up of a particularly innovative "counter-trigger" since it favors a fast operation with the sole hand holding the weapon, in a fully ambidextrous way.
Easy, simplified and economic storage: limited to the ready for use ammunitions. The suppression of the worn case collecting, treatment and reconditioning procedures is synonymous of substantial savings.
Quadruple weapon safety by introduction of a removable locker for trigger, breech, magazine well and disassembling bolt locking.
Systematic enabling of the gunners making the weapon according to the invention the true response to the problems of unauthorized use.

Operational use

Reduced size and weight: the principle of the invention makes it possible to position the recuperator spring, ensuring the recall of the slide in closed position, around the barrel. This provision is particularly advantageous as size regards since it avoids the use of any stem guide as required on the majority of the current weapons functioning with combined barrel and slide recess.

The weight of the weapon and its overall size profits from the suppression of this part. As example, the realization of an automatic handgun according to the invention would lead to a weight of the weapon, including a forty cartridges loaded magazine, lower than 700 grams.

Advantages of the tandem magazine: this disposition of the compartments combined with a three piles organisation of the ammunitions in the magazine makes it possible to carry up to three times the current magazines capacity, that is to say more than forty cartridges.

This device concentrates the fire power of a machine-gun in an automatic handgun, paving the way to a new market of compact and light weapons with superior fire power.

Unequalled discretion by absence of traces (cases) after shooting.

Reinforced effectiveness of the ammunition which benefit from a weight and size reduction up to 50% of that of the traditional ammunition with equal performances.

Increase in the fire power: for the same weight of ammunition, the effective (or projectable) mass is equal to that carried, that is to say 50% more than with classic ammunitions.

Suppression of the classical jamming risk encountered during cased cartridges ejection.

Suppression of chamber case adherence and the consecutive immobilization of the weapon.

Suppression of burns risks when a case comes into contact with the skin.

Maintenance and disassembling of the weapon simplified: the absence of disassembling key and other loose parts, make a weapon according to the invention a model particularly simple and quick to dismount for servicing.

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